Final Report

DEVELOPMENT OF VERSION TWO OF THE CALIFORNIA INTEGRATED TRANSPORTATION NETWORK (ITN)

AG-TS-90/210

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1 INTRODUCTION

This report is a revision to "Development of the California Integrated Transportation Network (ITN)" prepared by Wilkinson (2004). It has been revised to reflect the addition of new networks to the ITN as well as to reflect changes in data such as the hourly distribution of vehicle types and hourly distribution of VMT. The techniques described in Wilkinson (2004) were modified to prepare the second version of the ITN. Where necessary, the new data are also described.

Currently more than a dozen Metropolitan Planning Organizations (MPOs) as well as the California Department of Transportation (Caltrans) model transportation demand over various components of the California on-road transportation network. These individual networks have been used in past air quality modeling studies to aid in estimating emissions from on-road mobile sources. For urban scale air quality modeling domains (i.e., on the order of 300 km by 300 km), it was feasible to routinely use one or two of these individual networks to help estimate on-road mobile source emissions. However, as the extent of air quality modeling domains has grown to encompass regions on the order of 600 km by 600 km or larger, utilization of individual transportation networks to help estimate on-road mobile source emissions has grown much more difficult.

In an effort to help streamline the process of utilizing the individual transportation networks for use in estimating on-road mobile source emissions estimates, the California Air Resources Board proposed to develop a California statewide Integrated Transportation Network (ITN). Version one of the ITN, which is a seamless on-road transportation network covering the entire state of California, resulted from the integration of local MPO transportation networks as well as the Caltrans statewide network (Seitz, 2001). Version two of the ITN is similar to version one though version two utilizes a new Caltrans statewide network (Adamu, 2004) and incorporates additional MPO transportation networks. Further, ITN v.2.0 incorporates not only link-based networks but also incorporates the polygon-based transportation analysis zone (TAZ) coverages from each network. The inclusion of the TAZ coverages in ITN v.2.0 allows for the distribution of intrazonal VMT along links in the TAZ contrasted with the treatment of intrazonal VMT as single points (i.e., TAZ centroids) with ITN v.1.0.

The ITN is being used to develop inputs to version four of the Direct Travel Impact Model (DTIM) (Fieber and Ireson, 2001). DTIM coupled with EMFAC2002 (ARB, 2004), are used to estimate on-road mobile source emissions for the Central California Ozone Study (CCOS) (Fujita *et al*., 2001). Though the initial application of ITN will be for the CCOS, the ITN will also be useful in other studies of air quality for both ozone and particulate matter throughout California.

This report documents the development of version two of the ITN (ITN v.2.0). In Section Two, we discuss the source of the data that were used to develop the ITN v.2.0. And in Section Three, we discuss how the data were integrated to prepare the ITN v.2.0.

2 SOURCES OF DATA

The ITN v.2.0 is the result of combining numerous local MPO transportation networks and the Caltrans statewide transportation network. Table 2-1 identifies the networks that were used to prepare the ITN v.2.0, the counties represented in the network, the source of the data, and the network map projection parameters. The map projection parameters are necessary so that the networks can be cast in a consistent map projection (e.g., geographic coordinates).

Table 2-1. Source and projection parameters for each network used to create the ITN. Network names qualified by an '*' indicates that this network is newer than that used in the ITN v.1.0.

Network	Counties In Network	Native Map Projection	Parameters	Date Data Were Received	Base Year of Data	Information Provided By
*Statewide	All California Counties	Albers	Datum: NAD83 Units: meters 1st standard parallel: 34 0 0.0 2nd standard parallel: 40 30 0.0 central meridian: -120 0 0.0 latitude of origin: 0 0 0.0 False easting: 0.0 False northing: -4,000,000.0	20-Oct-2004	2000	Mr. Ayalew Adamu California Department of Transportation Transportation System Information PO Box 942873 Sacramento, CA 94273 916.653.2840
*Kern	Kern	Stateplane	Datum: NAD27 CA Zone: V ESRI Zone: 3376 FIPS: 0405 Units: feet	30-Aug-2004	1998	Mr. Mike Bitner Fresno Council of Governments (559) 233-4148 mbitner@fresnocog.org
*Madera	Madera	Stateplane	Datum: NAD27 CA Zone: III ESRI Zone: 3326 FIPS: 0403 Units: feet Conflation parameters were inferred from the data.	25-Aug-2004	2000	Mr. Mike Bitner Fresno Council of Governments (559) 233-4148 mbitner@fresnocog.org
*Merced	Merced	Stateplane	Datum: NAD83 CA Zone: III ESRI Zone: 3326 FIPS: 0403 Units: feet	30-Aug-2004	2000	Mr. Mike Bitner Fresno Council of Governments (559) 233-4148 mbitner@fresnocog.org
*Fresno	Fresno	Stateplane	Datum: NAD27 CA Zone: IV ESRI Zone: 3351 FIPS: 0404 Units: feet	30-Aug-2004	2000	Mr. Mike Bitner Fresno Council of Governments (559) 233-4148 mbitner@fresnocog.org
*Kings	Kings	Stateplane	Datum: NAD83 CA Zone: IV ESRI Zone: 3351 FIPS: 0404 Units: feet	25-Aug-2004	2000	Mr. Mike Bitner Fresno Council of Governments (559) 233-4148 mbitner@fresnocog.org
*San Joaquin	San Joaquin	Stateplane	Datum: NAD83 CA Zone: III ESRI Zone: 3326 FIPS: 0403 Units: feet	03-Sep-2004	1999	Mr. Mike Bitner Fresno Council of Governments (559) 233-4148 mbitner@fresnocog.org
*Stanislaus	Stanislaus	Stateplane	Datum: NAD83 CA Zone: III ESRI Zone: 3326 FIPS: 0403 Units: feet	31-Aug-2004	2000	Mr. Mike Bitner Fresno Council of Governments (559) 233-4148 mbitner@fresnocog.org

Network	Counties In Network	Native Map Projection	Parameters	Date Data Were Received	Base Year of Data	Information Provided By
*Tulare	Tulare	Stateplane	Datum: NAD83 CA Zone: IV ESRI Zone: 3351 FIPS: 0404 Units: feet	25-Aug-2004	2000	Mr. Mike Bitner Fresno Council of Governments (559) 233-4148 mbitner@fresnocog.org
*SCAG	Los Angeles Ventura Orange San Bernardino Riverside	UTM	Datum: NAD83 Units: meters Zone: 11 Conflation parameters were inferred from the data.	30-Nov-2004	2000	Mr. Srinivasa Bhat Southern California Association of Governments bhat@scag.ca.gov
*San Diego	San Diego	Stateplane	Datum: NAD83 CA Zone: VI ESRI Zone: 3401 FIPS: 0406 Units: feet	08-Apr-2005	2000	Mr. Bill McFarlane San Diego Association of Governments San Diego, CA 619.699.1976 bmc@sandag.org
*MTC	Alameda Contra Costa Marin Napa San Francisco San Mateo Santa Clara Solano Sonoma	UTM	Datum: NAD83 Units: meters Zone: 10	01-Dec-2004	2000	Mr. Chuck Purvis Metropolitan Transportation Commission (MTC) Oakland, CA 510.464.7731 cpurvis@mtc.ca.gov
SACMET	El Dorado Placer Sacramento Sutter Yolo	Stateplane	Datum: NAD27 ESRI Zone: 3301 CA Zone: II FIPS: 0402 Units: feet Projection parameters were inferred from data. Note that an x and y translation of 1,934,500.0 feet and 123,250.0 feet respectively were determined by trial and error and added to the network coordinates so that the network would properly align to county boundaries.	17-Jul-2001	1999	Mr. Ed Yotter California Air Resources Board Sacramento, CA 916.445.3300 eyotter@arb.ca.gov
Imperial	Not used since network conflation parameters could not be determined.					
San Luis Obispo	Not used since network conflation parameters could not be determined.					

The counties that did not have a specific transportation network associated with them other than the Statewide network include: Alpine; Amador; Butte; Calaveras; Colusa; Del Norte; Glenn; Humboldt; Imperial; Inyo; Lake; Lassen; Mariposa; Mendocino; Modoc; Mono; Monterey; Nevada; Plumas; San Benito; San Luis Obispo; Santa Cruz; Shasta; Sierra; Siskiyou; Tehama; Trinity; Tuolumne; and Yuba.

2.1 Period Definitions

In many instances, the data that were used to produce the ITN also included such information as average transit times on links, roadway names, and average speeds and volumes by period of the day (e.g., AM peak period, PM peak period, off-peak period, mid-day period). These data varied by network. For example, the AM period for the Los Angeles County network [i.e., 0500-0600, 0600-0700, 0700-0800 military] was not the same as an AM period for the Sacramento County network [i.e., 0600-0700, 0700-0800, 0800-0900 military]. Table 2-2 shows the periods of the day by network. The source of the period data is the same as that as identified in Table 2-1 unless otherwise noted. Further, some of the volume, production, and attraction data were supplied by trip type (e.g., a home-to-school trip, a home-to-work trip). Unlike ITN v.1.0 where trip type data stratification was maintained, all trip type stratified data in ITN v.2.0 were aggregated into total trips by period of day. This was done because (1) trip type stratification has no bearing on the outcome of the emissions estimates and (2) maintaining such stratified data in ARC/Info, which is the underlying software framework for the ITN, was problematic. Further, data such as peak periods were not made consistent across the networks (e.g., the AM peak period for Sacramento was not altered to be consistent with the AM peak period for Los Angeles).

Table 2-2. Period definitions for each network used to develop the ITN.

Network	Period			
	AM-Peak	**Mid-day Peak**	**PM-Peak**	**Off-Peak**
Statewide	*Data were for daily values*			
Kern	0700-0900	1100-1400	1500-1800	0000-0700 0900-1100 1800-2400
Madera	*Data were for daily values*			
Merced	*Data were for daily values*			
San Joaquin	0600-0800		1500-1700	0000-0600 0800-1500 1700-2400
Stanislaus	*Data were for daily values*			
Tulare	0700-1000		1500-1800	0000-0700 1000-1500 1800-2400
Kings	*Data were for daily values*			
Fresno	0700-1000		1500-1800	0000-0700 1000-1500 1800-2400
SCAG	0500-0800	0800-1400	1400-1800	0000-0500 1800-2400
Santa Barbara	0700-0800		1600-1700	0000-0700 0800-1600 1700-2400
San Diego	*Hourly data were provided by link and by vehicle class*			
MTC (MTC, 2004)	0700-0900		1600-1800	0000-0700 0900-1600 1800-2400
SACMET	0600-0900		1500-1800	0000-0600 0900-1500

Network	Period			
	AM-Peak	Mid-day Peak	PM-Peak	Off-Peak
				1800-2400
Imperial	Not used since network conflation parameters could not be determined.			
San Luis Obispo	Not used since network conflation parameters could not be determined.			

2.2 Base Year Network Summary

Table 2-3 identifies the base year, the link count, the link-based vehicle miles traveled (VMT), and the TAZ related data for each of the networks. The link- and TAZ-based VMT, as well as TAZ trip counts, are representative of an average weekday for peak summer travel for the year 2000 (i.e., the link and TAZ VMT and the TAZ trips reflect growth from the base year, as indicated in Table 2-3, to the year 2000). In California, peak summer travel occurs during the month of August (Caltrans 2002b). For the most part, the link counts and VMT data in Table 2-3 contain estimates only for the links that were used to prepare ITN v.2.0. That is, link counts and VMT do not include data for the gateway nodes, also known as cordon nodes, where it was possible to exclude the gateway nodes. Gateway nodes are used in the local transportation networks to estimate traffic that (1) originates outside the local transportation network but terminates within the local network (i.e., an external-to-internal trip), (2) originates inside the local transportation network but terminates outside the local network (i.e., an internal-to-external trip), or (3) originates and terminates outside the local transportation network but traverses some portion of the local network (i.e., an external-to-external trip). Since the gateway nodes contain estimates of trip counts for adjoining networks, the gateway nodes and their associated data are dropped from processing, where possible, during the network integration and reconciliation process since these data are presumably provided as components of data from adjoining networks.

Please note that the Tulare, Kings, Fresno, Merced, San Joaquin, Stanislaus, Kern and MTC networks had specific nodes that were identified as cordon nodes. These nodes were dropped during the process of creating the ITN v.2.0 (i.e., cordon node volumes were deleted during the network integrations and reconciliation process). However, some networks, (e.g., SACMET and Ventura), had nodes that looked suspiciously like cordon nodes (i.e., nodes at the boundaries of the network with unusually high travel volumes that were inconsistent with travel volumes immediately connected to the suspected cordon node). Though since there was no definitive evidence that indeed these suspicious nodes were cordon nodes, these suspicious nodes were included as components in the overall ITN creation effort. Hence, it is possible that for networks like SACMET and Ventura, travel volumes and VMT may be artificially inflated.

Table 2-3. Summary of link counts and VMT for each network used to create the ITN. Network names qualified by an '*' indicates that this network is newer than that used in the ITN v.1.0.

Network	Base Year	Link Count	Link-based VMT (miles)	TAZ-based VMT (miles)	TAZ Trip Productions	TAZ Trip Attractions
*Statewide	2000	3,348	69,119,942	1,234,341	3,528,361	3,656,862
*Kern	1998	10,378	19,215,223	4,176,958	3,927,633	3,927,633
*Madera	2000	3,541	3,336,380	240,997	1,318,224	1,424,637
*Merced	2000	6,406	9,889,523	292,217	4,195,030	5,503,110
*San Joaquin(2)	1999	8,560	13,903,073	362,237	850,581	853,744
*Stanislaus	2000	7,210	9,705,944	113,224	2,230,667	2,969,799

Network	Base Year	Link Count	Link-based VMT (miles)	TAZ-based VMT (miles)	TAZ Trip Productions	TAZ Trip Attractions
*Tulare	2000	15,120	14,773,534	4,012,355	4,704,633	4,704,633
*Kings	2000	4,637	3,274,029	885,739	792,079	792,079
*Fresno	2000	19,680	28,344,379	6,059,957	5,361,244	5,351,059
*Santa Barbara	2000	5,339	9,581,387	1,161,954	1,051,387	1,051,387
*San Diego	2000	27,636	79,602,675	1,066,279	5,411,359	5,403,216
SCAG						
SCAG	2000	89,474	373,072,370	2,358,055	8,781,690	8,791,874
*Los Angeles	2000	46,926	192,864,334	1,197,114	4,497,589	4,504,452
*Ventura	2000	4,628	19,066,770	282,839	505,452	503,035
*San Bernardino	2000	12,795	49,866,215	345,687	852,426	858,414
*Orange	2000	14,725	67,326,148	232,465	1,747,282	1,748,044
*Riverside	2000	10,400	43,948,903	299,950	1,178,941	1,177,929
MTC						
MTC	2000	29,856	138,650,838	471,258	5,752,439	7,370,648
*Alameda	2000	6,808	31,527,108	92,623	754,986	940,802
*Contra Costa	2000	3,859	17,977,602	47,521	127,421	127,421
*Marin	2000	1,086	6,092,371	4,255	81,498	81,498
*Napa	2000	444	2,097,669	33,340	133,939	141,043
*San Francisco	2000	3,954	8,161,786	27,412	141,479	141,479
*San Mateo	2000	2,958	16,936,172	76,440	1,127,484	1,517,106
*Santa Clara	2000	7,431	37,421,613	173,963	2,814,074	3,809,477
*Solano	2000	1,836	9,543,567	14,177	469,514	509,778
*Sonoma	2000	1,480	8,892,950	1,527	102,044	102,044
SACMET						
SACMET	1999	15,405	45,413,073	115,140	3,431,982	3,431,982
Placer	1999	1,918	7,305,299	63,244	2,086,464	2,086,464
Sutter	1999	134	2,742,999	13,691	202,691	202,691
El Dorado	1999	1,864	3,973,800	26,655	372,058	372,058
Yolo	1999	1,853	4,567,088	9,919	252,396	252,396
Sacramento	1999	9,636	26,823,887	1,631	518,373	518,373
Other Counties						
Imperial	Not used since network conflation parameters could not be determined					
San Luis Obispo	Not used since network conflation parameters could not be determined					

(1) Of this total, 35,507,120 miles were estimated to be from commercial truck travel as documented in Section 3.2.

(2) The original San Joaquin county network covered counties adjoining San Joaquin County. The original number of links in the network was 13,562. Only the links covering San Joaquin County were used to develop ITN v.2.0 since other MPOs provided data for the counties abutting San Joaquin. The VMT and trip counts shown in the table reflect the data specific to the links in San Joaquin.

2.3 Year-to-Year VMT Growth Factors by County

Because the local transportation networks contained data that represented a variety of years, it was necessary to collect data so that VMT could be projected to a consistent year. For purposes of this study, the common year was 2000. Table 2-4 shows the year-to-year projection factors that were developed from US Federal Highway Administration Highway Performance Monitoring System (HPMS) data and US EPA data (FHwA 2001a, b, c, d, e; USEPA 2001). Because these data were developed at the county level, VMT for every vehicle class on every link will be grown by an equal factor. That is, there is no link-to-link VMT growth factor variation.

Table 2-4. Year-to-Year VMT growth by county (FHwA 2001a, b, c, d, e; USEPA 2001).

FIPS County ID – County Name	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
1 – Alameda	0.0024	0.0128	0.0363	0.0328	0.0328
3 – Alpine	0.0292	0.0292	0.0292	0.0292	0.0292
5 – Amador	0.0292	0.0292	0.0292	0.0292	0.0292
7 – Butte	0.4863	-0.0480	-0.2192	0.0000	0.0000
9 – Calaveras	0.0292	0.0292	0.0292	0.0292	0.0292
11 – Colusa	0.0292	0.0292	0.0292	0.0292	0.0292
13 – Contra Costa	0.0079	0.0688	0.0287	0.0515	0.0515
15 – Del Norte	0.0292	0.0292	0.0292	0.0292	0.0292
17 – El Dorado	0.0379	0.0379	0.0379	0.0379	0.0379
19 – Fresno	0.0012	0.1017	0.0425	0.0110	0.0110
21 – Glenn	0.0292	0.0292	0.0292	0.0292	0.0292
23 – Humboldt	0.0291	0.0291	0.0291	0.0291	0.0291
25 – Imperial	0.0292	0.0292	0.0292	0.0292	0.0292
27 – Inyo	0.0292	0.0292	0.0292	0.0292	0.0292
29 – Kern	0.0178	0.0600	0.0122	0.0352	0.0352
31 – Kings	0.0291	0.0291	0.0291	0.0291	0.0291
33 – Lake	0.0292	0.0292	0.0292	0.0292	0.0292
35 – Lassen	0.0292	0.0292	0.0292	0.0292	0.0292
37 – Los Angeles	0.0063	0.0184	0.0132	0.0146	0.0146
39 – Madera	0.0346	0.0346	0.0346	0.0346	0.0346
41 – Marin	0.0188	0.0188	0.0188	0.0188	0.0188
43 – Mariposa	0.0292	0.0292	0.0292	0.0292	0.0292
45 – Mendocino	0.0292	0.0292	0.0292	0.0292	0.0292
47 – Merced	0.0510	0.0423	0.0164	-0.0586	-0.0586
49 – Modoc	0.0292	0.0292	0.0292	0.0292	0.0292
51 – Mono	0.0292	0.0292	0.0292	0.0292	0.0292
53 – Monterey	-0.0085	-0.0974	0.1671	0.0000	0.0000
55 – Napa	-0.0054	0.0588	0.0085	0.0746	0.0746
57 – Nevada	0.0292	0.0292	0.0292	0.0292	0.0292
59 – Orange	0.0294	0.0294	0.0294	0.0294	0.0294
61 – Placer	0.0371	0.0371	0.0371	0.0371	0.0371
63 – Plumas	0.0292	0.0292	0.0292	0.0292	0.0292
65 – Riverside	0.0065	0.0671	0.0333	0.0341	0.0341
67 – Sacramento	0.0348	0.0278	0.0150	0.0225	0.0225
69 – San Benito	0.0292	0.0292	0.0292	0.0292	0.0292
71 – San Bernardino	0.0002	0.0390	0.0355	0.0329	0.0329
73 – San Diego	0.0111	0.0095	0.0263	0.0501	0.0501
75 – San Francisco	0.0024	0.0128	0.0363	0.0328	0.0328
77 – San Joaquin	-0.0075	0.0655	0.0055	0.0183	0.0183

FIPS County ID – County Name	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000
79 – San Luis Obispo	0.0074	0.1995	-0.0739	0.0000	0.0000
81 – San Mateo	0.0186	0.0186	0.0186	0.0186	0.0186
83 – Santa Barbara	0.0032	0.2258	-0.2166	0.0232	0.0232
85 – Santa Clara	0.0056	0.0098	0.0273	0.0453	0.0453
87 – Santa Cruz	0.0243	-0.2405	0.3965	0.0000	0.0000
89 – Shasta	0.0129	0.5773	-0.2758	0.0000	0.0000
91 – Sierra	0.0292	0.0292	0.0292	0.0292	0.0292
93 – Siskiyou	0.0292	0.0292	0.0292	0.0292	0.0292
95 – Solano	-0.1314	-0.2109	0.5284	0.0172	0.0172
97 – Sonoma	0.0126	0.0820	0.0353	0.0371	0.0371
99 – Stanislaus	-0.0067	0.0672	0.0168	0.0089	0.0089
101 – Sutter	0.0276	0.0275	0.0275	0.0276	0.0276
103 – Tehama	0.0292	0.0292	0.0292	0.0292	0.0292
105 – Trinity	0.0292	0.0292	0.0292	0.0292	0.0292
107 – Tulare	0.0206	0.0463	0.0596	0.0054	0.0054
109 – Tuolumne	0.0292	0.0292	0.0292	0.0292	0.0292
111 -- Ventura	0.0072	0.0084	0.0285	0.0501	0.0501
113 – Yolo	-0.0414	0.0247	0.1769	0.0256	0.0256
115 – Yuba	0.0029	0.7208	-0.1068	0.0000	0.0000

2.4 Weekend Day and Weekday Factors

With version one of the ITN, weekend day factors were developed and applied to the week day ITN data such that weekend day VMT, volumes, and trips were estimated. Further, the diurnal variation of weekend day VMT, volumes, and trips were adjusted to reflect suspected hourly on-road mobile source activity. This was not done with version two of the ITN given that there is on-going research at ARB to develop new factors to estimate weekend day on-road mobile source activity. Further, there is no clear means to alter the individual EMFAC2002 vehicle class diurnal patterns.

As shown in Figure 2-1, ITN v.2.0 now maintains individual diurnal patterns for VMT for each EMFAC2002 vehicle class. Figure 2-1 shows the hourly fractional distribution of VMT for Alameda County by vehicle category. Figure 2-2 shows the hourly estimated VMT for all vehicle classes in Alameda County. Because personal car travel overwhelms the overall distribution of VMT, Figure 2-3 shows hourly estimated VMT for the light duty truck, medium duty, and light heavy-duty vehicle classes, and Figure 2-4 shows the remaining EMFAC2002 vehicle categories.

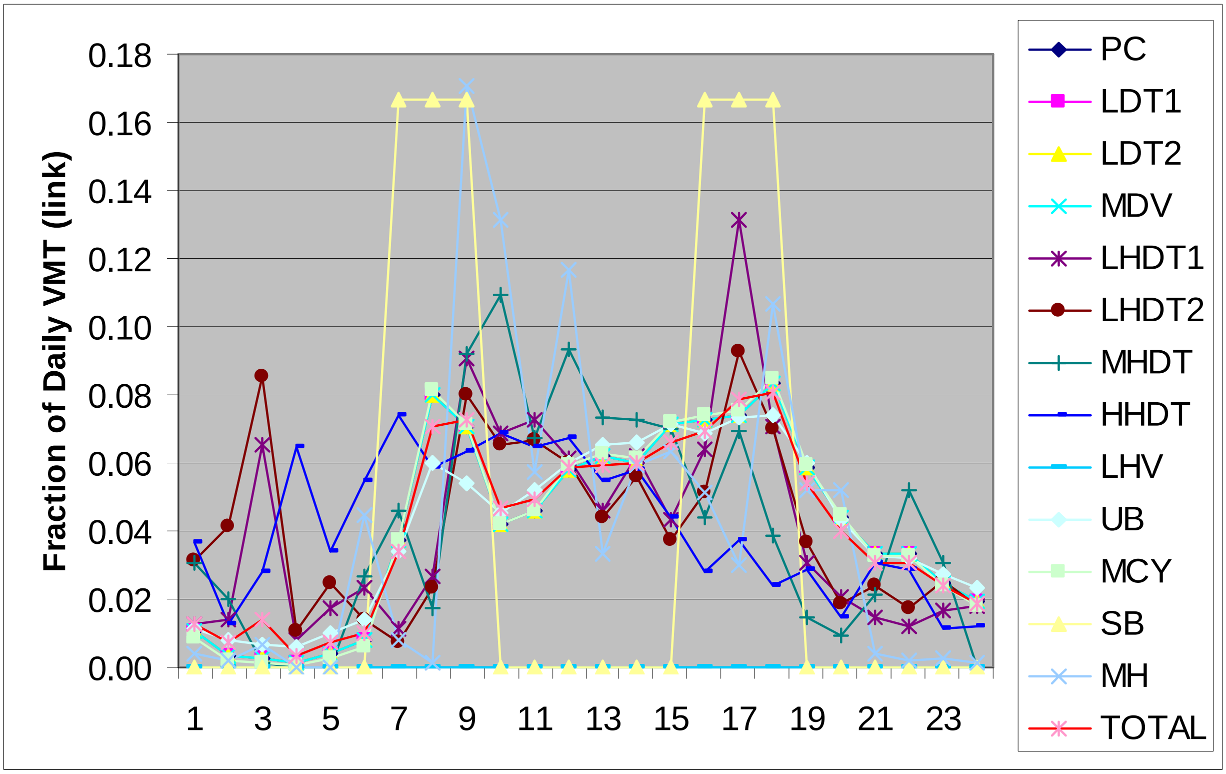

Figure 2-1. Typical diurnal patterns for link-based VMT for each EMFAC20002 vehicle class. The example shown here is for July 2000 for Alameda County. Please note that five vehicle classes have identical patterns: PC; LDT1; LDT2; MDV; and MC. Also note that classes such as school bus (SB) and motor homes (MH) have periods where EMFAC2002 indicates no activity (i.e., fraction of VMT is zero). For example, EMFAC2002 indicates that MH exhibits no activity during the hours of 0400 and 0500.

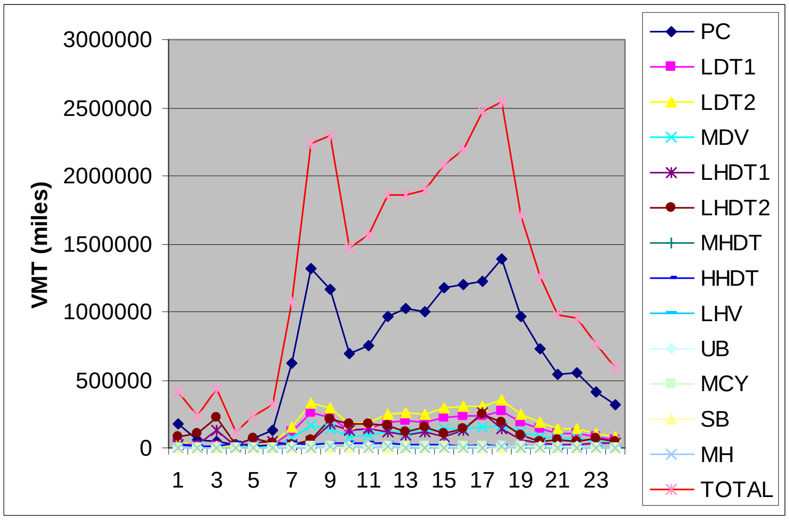

Figure 2-2. Estimated hourly link-based VMT (miles) for all vehicle categories in Alameda County in July 2002.

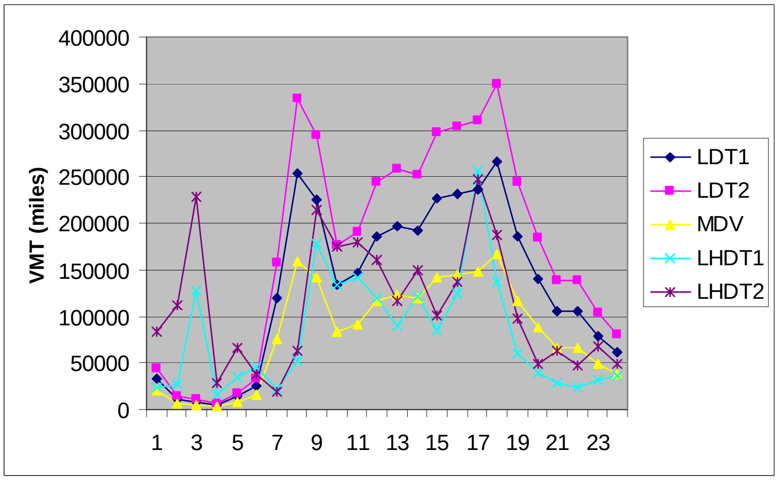

Figure 2-3. Estimated hourly link-based VMT (miles) for selected classes in Alameda County in July 2002.

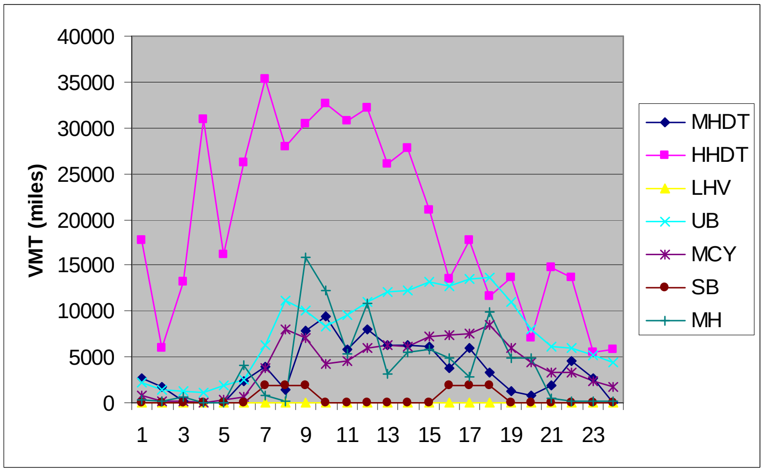

Figure 2-4. Estimated hourly link-based VMT (miles) for selected classes in Alameda County in July 2002.

3 METHODS TO PREPARE ITN

The following steps were taken to prepare the ITN v.2.0:

- Step 1 – Develop consistent ARC-compatible input data for each network, project base year data to common year, and compute hourly data;
- Step 3 – Add commercial VMT to Caltrans statewide network; and
- Step 2 – Merge local networks into one consistent network.

Each of these steps is described in the following sections.

3.1 Step 1 – Develop Consistent ARC-compatible Input Data for Each Network

For purposes of this study, SAS, v.6.12, (SAS, 1998) and ARC/Info, v.8.1.2, (ESRI, 1998) were the primary software tools that were used to prepare the ITN v.2.0. SAS provides tools to quickly manipulate and statistically analyze data. ARC/Info is a geographical information system (GIS) that provides tools to spatially analyze and display data. The ITN v.2.0 was prepared on a Sun Solaris, v.5.8, Unix system. SAS and ARC/Info scripts that were used to build and manipulate the ITN v.2.0 are included on a CD attached to this report.

In the following subsections, the raw data that were used to develop the ITN v.2.0 are described. The SAS and ARC/Info scripts that are used to create consistently formatted data sets are also described. Note that each of the scripts needs to be modified in order to run on different computer systems or on different data sets. The SAS and ARC/Info scripts contain documentation that will guide the user as to how to modify the scripts. Further, the SAS and ARC/Info scripts contain documentation on the format of the data and the source of the data.

In the following subsections, only the data that are new to ITN v.2.0 are described. For a description of data that were used to construct ITN v.1.0 and are used again to construct ITN v.2.0, please refer to Wilkinson (2004).

3.1.1 Contents of CD – Raw Network Data for Fresno County

Because the local networks were provided in a variety of formats, it was first necessary to put all of the data into a format that was consistent and readable by ARC/Info. The attached CD contains a directory called “raw network data.” “raw network data” contains additional directories which contain the raw data, ARC/Info scripts, and SAS scripts that were used to build the local networks, which comprise the ITN.

In the directory “fresno,” the following files exist:

- fresno_2000_link.*;
- fresno_taz_080204.*;
- iz_vmt.txt
- create_fresno_taz.aml; and

- create_fresno_network.aml.

fresno_2000_link is a shape file that contains the link-based data, and fresno_taz_080204 is a shape file that contains the TAZ-based data. The file iz_vmt.txt contains the daily VMT for each TAZ. The ARC AML scripts create_fresno_taz.aml and create_fresno_network.aml are self contained programs that convert the Fresno link- and TAZ-based shape files into consistent ARC coverages that were used to construct version two of the ITN.

create_fresno_network.aml creates consistent Info data sets from data contained in the shape files and grows base year data to a common year using data from Table 2-4. The AML script uses the methods defined in Chapter 3.3 of Wilkinson (2004). Table 3-1 shows the consistent link-based attributes Info data set, and Table 3-2 shows the consistent node-based attributes Info data set. Further, create_fresno_network.aml allocates period-based data to each hour of the day by vehicle class (Table 3-3). create_fresno_taz.aml populates a consistent Info data set (Table 3-4) with TAZ-based data, and it also allocates intrazonal travel volumes and trip counts (both productions and attractions) to each hour of the day by vehicle class (Table 3-5). The data to allocate the link-based and TAZ-based travel volumes (Table 3-6) and TAZ-based trip counts (Table 3-7) to each hour of the day are taken from hourly default data contained in EMFAC2002 (ARB, 2004). For the cases where MPOs did not supply trip counts or speeds data, default trip counts (Table 3-7) and default speeds (Table 3-8) from EMFAC2002 are used directly to populate the data for ITN v.2.0. The data contained in the ASCII data files represented by Tables 3-6, 3-7, and 3-8 were extracted from EMFAC2002 using the SAS and AutoIt scripts contained on the CD in the directory "emfac." Finally, Figure 3-1 shows the relationships between the ITN v.2.0 data tables.

Note that there is one distinct difference in how data are maintained in version two of the ITN when compared to version one of the ITN. In ITN v.1.0, trip type was maintained as a distinct attribute. This is not the case in ITN v.2.0. All trip types have been collapsed into a single estimate since (1) trip type stratification has no bearing on the outcome of the emissions estimates and (2) maintaining such stratified data in ARC/Info, which is the underlying software framework for the ITN, is problematic.

Table 3-1. Consistent link-based ARC/Info attribute table used to create the ITN v.2.0.

Attribute	Byte Length	Output Length	Type	Decimals	Description
FNODE#	4	5	B	-	unique internal from node
TNODE#	4	5	B	-	unique internal to node
LPOLY#	4	5	B	-	unique internal left polygon id (not used)
RPOLY#	4	5	B	-	unique internal right polygon id (not used)
LENGTH	4	12	F	3	internal link length (degrees)
ITN_GEO#	4	5	B	-	internal link id
ITN_GEO-ID	4	5	B	-	user-defined link id
modify	4	1	I	-	code to indicate the nature of a modified link 0 – unmodified link 1 – manually modified link 2 – unmodified link but automatically split during reconciliation 3 – modified link and automatically split during reconciliation
netname	30	30	C	-	original name of the network
baseyear	4	4	I	-	base year of the link-based data
growyear	4	4	I	-	year to which link-based data were grown (should always by 2000)

Attribute	Byte Length	Output Length	Type	Decimals	Description
state_fips	2	2	C	-	state FIPS code (should always be 06 for California)
county_fips	3	3	C	-	county FIPS code
a	4	5	B	-	A node as identified in original network
b	4	5	B	-	B node as identified in original network
name	20	20	C	-	street, road, freeway name
olength	4	6	F	3	original link length as identified in original network (miles)
mlength	4	6	F	3	link length after incorporation into ITN (miles)
factype	4	2	B	-	link facility type 0 – dummy link or unclassified 1 – interstate 2 – freeways & expressways 3 – principal arterial 4 – principal arterial (other) 5 – centroid connector 6 – minor arterial 7 – major collector 8 – minor collector 9 – local
lanecount	4	2	B	-	number of directional lanes
lanecap	4	5	B	-	lane vehicle capacity (vehicles/lane/hour)
freflospd	4	5	F	1	free flow speed (miles per hour)
volam	4	5	B	-	grow year AM peak volume
volmd	4	5	B	-	grow year mid-day peak volume
volpm	4	5	B	-	grow year PM peak volume
volof	4	5	B	-	grow year off peak volume
volda	4	5	B	-	grow year daily volume
cspdam	4	5	F	1	AM peak link speed (miles per hour)
cspdmd	4	5	F	1	mid-day link peak speed (miles per hour)
cspdpm	4	5	F	1	PM peak link speed (miles per hour)
cspdof	4	5	F	1	off peak link speed (miles per hour)
cspdda	4	5	F	1	daily average link speed (miles per hour)
vmtam	4	12	F	3	grow year AM peak VMT (miles)
vmtmd	4	12	F	3	grow year mid-day peak VMT (miles)
vmtpm	4	12	F	3	grow year PM peak VMT (miles)
vmtof	4	12	F	3	grow year off peak VMT (miles)
vmtda	4	12	F	3	grow year daily VMT (miles)

Table 3-2. Consistent node-based ARC/Info attribute table used to create the ITN v.2.0.

Attribute	Byte Length	Output Length	Type	Decimals	Description
ARC#	4	5	B	-	internal ARC identifier
ITN_GEO#	4	5	B	-	internal ARC node identifier
ITN_GEO-ID	4	5	B	-	internal ARC node identifier
X-COORD	4	12	F	5	longitude of node (degrees)
Y-COORD	4	12	F	5	latitude of node (degrees)
elevation	4	12	F	5	node elevation (feet)
FNODE#	4	5	B	-	from-node (used for relation into link attribute table)
TNODE#	4	5	B	-	to-node (used for relation into link attribute table)

Table 3-3. ITN v.2.0 hourly link volumes and speeds by vehicle class.

Attribute	Byte Length	Output Length	Type	Decimals	Description
ITN_GEO-ID	4	5	B	-	user-defined link id
V*vchr*	4	12	F	1	hourly volumes by vehicle class where *vc* is vehicle class with valid values of 01, 02, 03, …, 13; and *hr* is hour of day with valid values of 01, 02, 03, …, 24. Valid vehicle classes (*vc*) 01 – passenger car 02 – light-duty trucks (T1) 03 – light-duty trucks (T2) 04 – medium-duty trucks (T3) 05 – light heavy-duty trucks (T4) 06 – light heavy-duty trucks (T5) 07 – medium heavy-duty trucks (T6) 08 – heavy heavy-duty trucks (T7) 09 – line haul vehicles (T8) 10 – urban bus 11 – motorcycle 12 – school bus 13 – motor homes
S*hr*	4	12	F	5	average hourly speed of fleet (miles per hour) where *hr* is hour of day with valid values of 01, 02, 03, …, 24

Table 3-4. Consistent TAZ-based ARC/Info attribute table used to create the ITN v.2.0.

Attribute	Byte Length	Output Length	Type	Decimals	Description
AREA	4	12	F	5	internally computed area (square degrees)
PERIMETER	4	12	F	5	internally computed perimeter (degrees)
ITN_TAZ#	4	5	B	-	internal polygon identifier
ITN_TAZ-ID	4	5	B	-	internal polygon identifier
state_fips	2	2	C	-	state FIPS code (should always be 06 for California)
county_fips	3	3	C	-	county FIPS code
tazid	4	5	B	-	user-defined TAZ identifier
netname	30	30	C	-	original name of the network
baseyear	4	4	I	-	base year of the TAZ-based data
growyear	4	4	I	-	year to which TAZ-based data were grown (should always by 2000)
freflospd	4	5	F	1	free flow speed (miles per hour)
izdist	4	5	F	1	intrazonal distance (miles)
izvolam	4	5	B	-	grow year AM peak volume
izvolmd	4	5	B	-	grow year mid-day peak volume
izvolpm	4	5	B	-	grow year PM peak volume
izvolof	4	5	B	-	grow year off peak volume
izvolda	4	5	B	-	grow year daily volume
izvmtam	4	5	B	-	grow year AM peak VMT (miles)
izvmtmd	4	5	B	-	grow year mid-day peak VMT (miles)
izvmtpm	4	5	B	-	grow year PM peak VMT (miles)
izvmtof	4	5	B	-	grow year off peak VMT (miles)
izvmtda	4	5	B	-	grow year daily VMT (miles)
izspdam	4	5	F	1	AM peak link speed (miles per hour)
izspdmd	4	5	F	1	mid-day link peak speed (miles per hour)
izspdpm	4	5	F	1	PM peak link speed (miles per hour)
izspdof	4	5	F	1	off peak link speed (miles per hour)
izspdda	4	5	F	1	daily average link speed (miles per hour)
izpram	4	5	F	1	AM peak intrazonal trip productions for all trip types
izprmd	4	5	F	1	mid-day intrazonal trip productions for all trip types
izprpm	4	5	F	1	PM peak intrazonal trip productions for all trip types
izprof	4	5	F	1	off peak intrazonal trip productions for all trip types
izprda	4	5	F	1	daily average intrazonal trip productions for all trip types
izatam	4	5	F	1	AM peak intrazonal trip attractions for all trip types
izatmd	4	5	F	1	mid-day intrazonal trip attractions for all trip types
izatpm	4	5	F	1	PM peak intrazonal trip attractions for all trip types

Attribute	Byte Length	Output Length	Type	Decimals	Description
izatof	4	5	F	1	off peak intrazonal trip attractions for all trip types
izatda	4	5	F	1	daily average intrazonal trip attractions for all trip types

Table 3-5. ITN v.2.0 hourly TAZ volumes, speeds, productions and attractions by vehicle class.

Attribute	Byte Length	Output Length	Type	Decimals	Description
ITN_TAZ-ID	4	5	B	-	internal polygon identifier (is unique)
tazid	4	5	B	-	network-specific TAZ identifier (is not unique)
V*vchr*	4	12	F	1	hourly volumes by vehicle class where *vc* is vehicle class with valid values of 01, 02, 03, …, 13; and *hr* is hour of day with valid values of 01, 02, 03, …, 24. Valid vehicle classes (*vc*) 01 – passenger car 02 – light-duty trucks (T1) 03 – light-duty trucks (T2) 04 – medium-duty trucks (T3) 05 – light heavy-duty trucks (T4) 06 – light heavy-duty trucks (T5) 07 – medium heavy-duty trucks (T6) 08 – heavy heavy-duty trucks (T7) 09 – line haul vehicles (T8) 10 – urban bus 11 – motorcycle 12 – school bus 13 – motor homes
P*vchr*	4	12	F	1	hourly trip productions by vehicle class where *vc* is vehicle class with valid values of 01, 02, 03, …, 13; and *hr* is hour of day with valid values of 01, 02, 03, …, 24.
A*vchr*	4	12	F	1	hourly trip attractions by vehicle class where *vc* is vehicle class with valid values of 01, 02, 03, …, 13; and *hr* is hour of day with valid values of 01, 02, 03, …, 24.
S*hr*	4	12	F	1	average hourly speed of fleet (miles per hour) where *hr* is hour of day with valid values of 01, 02, 03, …, 24

Table 3-6. Default hourly vehicle mix from EMFAC2002 (ASCII file *vmt_frac_dump_by_hour_vehicle_class.dat*).

Attribute	Type	Description
state fips	I	state FIPS code (should always be 06 for California)
county fips	I	county FIPS code
year	I	year of EMFAC data
month	I	month of EMFAC data (01-12)
vehicle class	I	Valid vehicle classes 01 – passenger car 02 – light-duty trucks (T1) 03 – light-duty trucks (T2) 04 – medium-duty trucks (T3) 05 – light heavy-duty trucks (T4) 06 – light heavy-duty trucks (T5) 07 – medium heavy-duty trucks (T6) 08 – heavy heavy-duty trucks (T7) 09 – line haul vehicles (T8) 10 – urban bus 11 – motorcycle 12 – school bus 13 – motor homes
f01-f24	F	hourly VMT fractions

Table 3-7. Default hourly trip counts from EMFAC2002 (ASCII file *trip_dump.dat*).

Attribute	Type	Description
state fips	I	state FIPS code (should always be 06 for California)
county fips	I	county FIPS code
year	I	year of EMFAC data
month	I	month of EMFAC data (01-12)
vehicle class	I	Valid vehicle classes 01 – passenger car 02 – light-duty trucks (T1) 03 – light-duty trucks (T2) 04 – medium-duty trucks (T3) 05 – light heavy-duty trucks (T4) 06 – light heavy-duty trucks (T5) 07 – medium heavy-duty trucks (T6) 08 – heavy heavy-duty trucks (T7) 09 – line haul vehicles (T8) 10 – urban bus 11 – motorcycle 12 – school bus 13 – motor homes
fuel type	I	Valid fuel types 01 – gasoline 02 – diesel 03 – electric
t01-t24	F	hourly trip counts

Table 3-8. Default hourly speeds from EMFAC2002 (ASCII file speed_*dump.dat*).

Attribute	Type	Description
state fips	I	state FIPS code (should always be 06 for California)
county fips	I	county FIPS code
year	I	year of EMFAC data
month	I	month of EMFAC data (01-12)
vehicle class	I	Valid vehicle classes 01 – passenger car 02 – light-duty trucks (T1) 03 – light-duty trucks (T2) 04 – medium-duty trucks (T3) 05 – light heavy-duty trucks (T4) 06 – light heavy-duty trucks (T5) 07 – medium heavy-duty trucks (T6) 08 – heavy heavy-duty trucks (T7) 09 – line haul vehicles (T8) 10 – urban bus 11 – motorcycle 12 – school bus 13 – motor homes
fuel type	I	Valid fuel types 01 – gasoline 02 – diesel 03 – electric
s01-s24	F	hourly speeds (miles per hour)

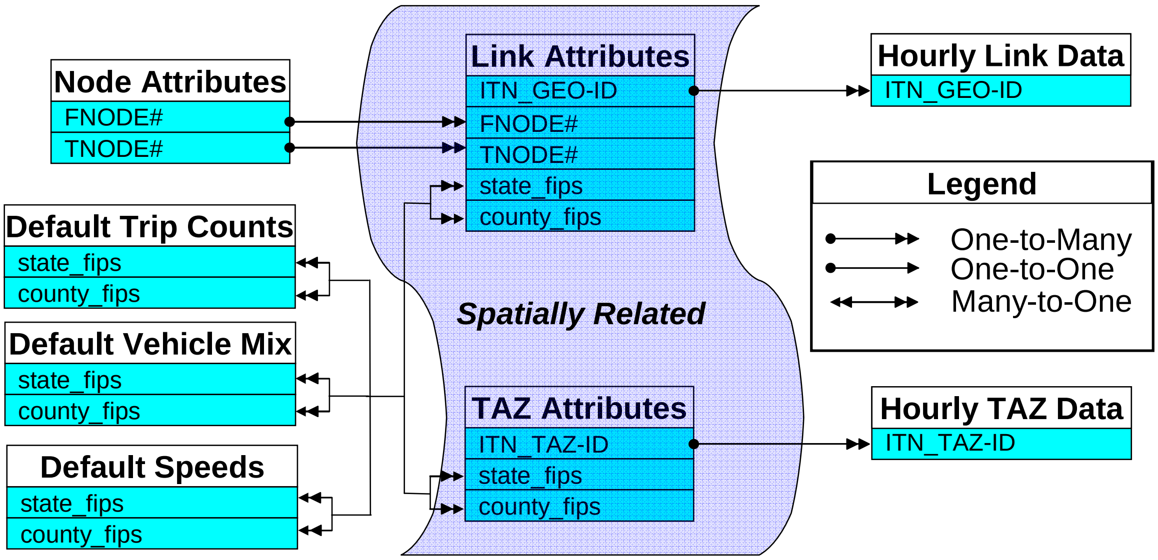

Figure 3-1. Relationships among the ITN v.2.0 data tables

Attribute refers to the name of the variable in the data table. *Byte Length* refers to the internal length of the *attribute* in the data table. *Output Length* refers to the length of the *attribute* when it is displayed on the screen or in a printout. *Type* refers to the *attribute* type: C is a character variable; I is an integer variable; B is a binary variable (positive integers only); and F is a floating point or real number. *Decimals* refer to the number of digits displayed after the decimal point for real variables when values are displayed to the screen or in a printout. *Description* refers to a brief definition of the *attribute*.

3.1.2 Contents of CD – Raw Network Data for Kern County

In the directory "kern," the following files exist:

- kern_1998_link.*;
- kern_taz.*;
- kern_taz_vmt.dat;
- create_kern_taz.aml; and
- create_kern_network.aml.

kern_1998_link is a shape file that contains the link-based data, and kern_taz is a shape file that contains the TAZ-based data. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. kern_taz_vmt.dat contains the AM, mid-day, PM, off-peak and daily intrazonal VMT. create_kern_network.aml is equivalent to create_fresno_network.aml, and create_kern_taz.aml is equivalent to create_fresno_taz.aml.

3.1.3 Contents of CD – Raw Network Data for Kings County

In the directory “kings,” the following files exist:

- kcag_2002_link.*;
- tazs.*;
- vmt_iz.txt;
- create_kings_taz.aml; and
- create_kings_network.aml.

kcag_2002_link is a shape file that contains the link-based data, and tazs is a shape file that contains the TAZ-based data. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. vmt_iz.txt contains the daily intrazonal VMT. create_kings_network.aml is equivalent to create_fresno_network.aml, and create_kings_taz.aml is equivalent to create_fresno_taz.aml.

3.1.4 Contents of CD – Raw Network Data for Madera County

In the directory “madera,” the following files exist:

- madera_2000_link.*;
- madera_2000taz.*
- create_madera_taz.aml; and
- create_madera_network.aml.

madera_2000_link is a shape file that contains the link-based data, and madera_2000taz is a shape file that contains the TAZ-based data. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. vmt_iz.txt contains the daily intrazonal VMT. create_madera_network.aml is equivalent to create_fresno_network.aml, and create_madera_taz.aml is equivalent to create_fresno_taz.aml.

3.1.5 Contents of CD – Raw Network Data for Merced County

In the directory “merced,” the following files exist:

- merced_2000_link.*;
- merced_taz.*
- vmt_iz.txt
- create_merced_taz.aml; and
- create_merced_network.aml.

merced_2000_link is a shape file that contains the link-based data, and merced_taz is a shape file that contains the TAZ-based data. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. vmt_iz.txt contains a default set of daily intrazonal VMT. With the original submittal of these data, no intrazonal VMT or volume estimates were submitted; hence it was necessary to prepare a default intrazonal VMT file, which contains a nominal estimate of one VMT per TAZ. create_merced_network.aml is equivalent to create_fresno_network.aml, and create_merced_taz.aml is equivalent to create_fresno_taz.aml.

3.1.6 Contents of CD – Raw Network Data for the Metropolitan Transport Commission (MTC) Network

In the directory “mtc,” the following files exist:

- hwynet_dailyload_year2000.*
- bayarea_rtaz1454_rev1.*;
- iztermdata2000.dat;
- create_mtc_taz.aml; and
- create_mtc_network.aml.

The MTC network covers portions of Sonoma and Solano counties and all of Marin, Napa, Contra Costa, Alameda, Santa Clara, San Mateo, and San Francisco counties. The shape file hwynet_dailyload_year2000 contains peak period and off-peak period link volumes and other associated link data for the MTC network. The shape file bayarea_rtaz1454_rev1 contains the polygon coverage of the MTC transportation analysis zones. MTC intrazonal data (i.e., iztermdata2000.dat) was provided as an ASCII file and contains AM, PM, and off-peak estimates of intrazonal VMT and trip productions and attractions. As with the Fresno network, ARC is used to read the shape file, add map projection data (per Table 2-1), and project the network to the common coordinate system. create_mtc_network.aml is equivalent to create_fresno_network.aml. create_mtc_taz.aml is equivalent to create_fresno_taz.aml.

3.1.7 Contents of CD – Raw Network Data for the Sacramento Metropolitan (SACMET) Region

In the directory “sacmet,” the following files exist:

- sacmet_1999.*
- taz_centroids.arc;
- taz_centroids_data.arc;
- create_sacmet_taz.aml; and
- create_sacmet_network.aml.

The SACMET network covers Sacramento, El Dorado, Sutter, Yolo, and Placer counties. The shape file sacmet_q999 contains peak period and off-peak period link volumes and other associated link data for the SACMET network. Staff at the Sacramento Area Council of Governments (SACOG) did not provide an update to their data for use in developing ITN v.2.0; hence, it was necessary to utilize data that were provided previously for use in building ITN v.1.0. The original SACMET data submittal did not include any data that defined the polygon boundaries of the TAZs. Therefore, it was necessary to infer such from the data at hand. taz_centroids.arc contained the location of the TAZ centroids. Using these data, a pseudo-TAZ coverage was constructed as the square of two times the intrazonal distance centered on the TAZ centroid (i.e., square polygons). As with the Fresno network, ARC is used to read the shape file, add map projection data (per Table 2-1), and project the network to the common coordinate system. create_sacmet_network.aml is equivalent to create_fresno_network.aml. create_sacmet_taz.aml is equivalent to create_fresno_taz.aml.

3.1.8 Contents of CD – Raw Network Data for San Diego County

In the directory “san_diego,” the following files exist:

- hwycov.*;
- zones.*
- create_san_diego_taz.aml; and
- create_san_diego_network.aml.

hwycov is a shape file that contains the link-based data, and zones is a shape file that contains the TAZ-based data. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. create_san_diego_network.aml is equivalent to create_fresno_network.aml, and create_san_diego_taz.aml is equivalent to create_fresno_taz.aml.

3.1.9 Contents of CD – Raw Network Data for San Joaquin County

In the directory “san_joaquin,” the following files exist:

- san_joaquin_1999_link.*;
- sj_taz.*
- vmt_iz.txt;
- create_san_joaquin_taz.aml; and
- create_san_joaquin_network.aml.

san_joaquin_1999_link is a shape file that contains the link-based data, and sj_taz is a shape file that contains the TAZ-based data. Of note, though the shape file san_joaquin_1999_link contains links for not only San Joaquin but many of the counties surrounding San Joaquin County, including the entire Bay area and SACOG counties, only those links for San Joaquin County were used to develop ITN v.2.0. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. vmt_iz.txt is an ASCII file that contains the intrazonal daily volumes and intrazonal daily trip productions and attractions. create_san_joaquin_network.aml is equivalent to create_fresno_network.aml, and create_san_joaquin_taz.aml is equivalent to create_fresno_taz.aml.

3.1.10 Contents of CD – Raw Network Data for Santa Barbara County

In the directory "sbcag," the following files exist:

- sbcag_2000adt_ampm_flow_sp.*;
- sbcag_taz.*;
- vmt_iz.txt;
- create_sbcag_taz.aml; and
- create_sbcag_network.aml.

sbcag_2000adt_ampm_flow_sp is a shape file that contains the link- and node-based data, and sbcag_taz is a shape file that contains the TAZ-based data. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. vmt_iz.txt contains a default set of daily intrazonal VMT. With the original submittal of these data, no intrazonal VMT or volume estimates were submitted; hence it was necessary to prepare a default intrazonal VMT file, which contains a nominal estimate of one VMT per TAZ. create_sbcag_network.aml is equivalent to create_fresno_network.aml, and create_sbcag_taz.aml is equivalent to create_fresno_taz.aml.

3.1.11 Contents of CD – Raw Network Data for the Southern California Association of Governments (SCAG)

In the directory "scag," the following files exist:

- adt2000.*;
- am2000.*
- md2000.*;
- pm2000.*;
- nt2000.*;
- taz99.*;
- vmt_iz.txt;
- create_scag_taz.aml; and
- create_scag_network.aml.

adt2000 is a shape file that contains the daily link-based data; am2000, md2000, pm2000, and nt2000 are shape files that contain AM, mid-day, PM, and off-peak, respectively, link-based data; and taz99 is a shape file that contains the TAZ-based data. Please note that the link-based data represent conditions in the year 2000 while the TAZ-based data represent the year 1999. The intrazonal data for the year 2000 were never delivered by the staff at SCAG. Instead, the TAZ data were extracted from a submittal of data from ARB that was delivered to Alpine Geophysics in June of 2001. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. vmt_iz.txt contains a default set of daily intrazonal VMT. create_scag_network.aml is equivalent to create_fresno_network.aml, and create_scag_taz.aml is equivalent to create_fresno_taz.aml.

3.1.12 Contents of CD – Raw Network Data for Stanislaus County

In the directory "stanislaus," the following files exist:

- stan_2000_link.*;
- stantaz.*
- iz_vol.txt;
- create_stanislaus_taz.aml; and
- create_stanislaus_network.aml.

stan_2000_link is a shape file that contains the link-based data, and stantaz is a shapefile that contains the TAZ-based data. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. iz_vol.txt contains the intrazonal daily volumes, trip productions and attractions, and intrazonal distance. create_stanislaus_network.aml is equivalent to create_fresno_network.aml, and create_stanislaus_taz.aml is equivalent to create_fresno_taz.aml.

3.1.13 Contents of CD – Raw Network Data for the California Statewide Network

In the directory "caltrans," the following files exist:

- ca00_hwy_vol.*;
- stmtaz_nad83-2.*;
- create_statewide_taz.aml;
- create_statewide_network_itn.aml; and
- create_statewide_network.aml.

ca00_hwy_vol is a shape file that defines the link- and node-based data. stmtaz_nad83-2 is a shape file that contains the TAZ-based data. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. create_statewide_network_itn.aml and create_statewide_network.aml are equivalent to create_fresno_network.aml. create_statewide_network_itn.aml builds the network for only that portion of the Caltrans statewide network that is used to construct the ITN v.2.0 while create_statewide_network.aml is used to create the entire Caltrans statewide network. create_statewide_taz.aml is equivalent to create_statewide_taz.aml.

3.1.14 Contents of CD – Raw Network Data for Tulare County

In the directory "tulare," the following files exist:

- tulare_2003_link.*;
- base_taz.*
- iz_vol.txt;
- create_tulare_taz.aml; and
- create_tulare_network.aml.

tulare_2003_link is a shape file that contains the link-based data, and base_taz contains the TAZ-based data. As with the Fresno network, ARC is used to read the shape files, add map projection data (per Table 2-1), and project the network to the common coordinate system. iz_vol.txt contains the AM, PM, and off-peak intrazonal volumes. create_tulare_network.aml is equivalent to create_fresno_network.aml, and create_tulare_taz.aml is equivalent to create_fresno_taz.aml.

3.2 Step 2 – Add Commercial VMT to Caltrans Statewide Network

Once the Caltrans statewide network and the network that represented the portion of the ITN v.2.0, which was extracted from the Caltrans statewide network, were prepared, it was necessary to estimate commercial VMT for the portion of the ITN v.2.0 represented by the Caltrans statewide network (Adamu, 2004). Though the other networks that were supplied for use in this study included estimates of commercial VMT integrated into the overall VMT, the statewide network has VMT estimates for only personal travel.

In order to estimate commercial VMT for the Caltrans statewide network, the following must be performed:

- Run create_caltrans_network.aml (described in section 3.1.13);
- Run create_caltrans_network_itn.aml (described in Section 3.1.13);
- Run create_projected_network.aml;
- Determine external stations;
- Run routes.aml;
- Start the gravity model;
- Load the distance matrix created by routes.aml into the gravity model;
- Alter the intrazonal distances to be representative of intrazonal truck travel;
- Run all gravity model macros;
- Run distribute_trips_to_network.sas; and
- Run add_trips_to_network_and_compute_commercial_vmt.aml.

All code necessary to run the gravity model is located in the directory "gravity_model" on the CD, except for the AML scripts create_caltrans_network_itn.aml and create_caltrans_network.aml which are located elsewhere.

Because the standard map projection that was used to build the networks was geographic, it was necessary to project the Caltrans networks to a map system more suitable for determining distance. In this case, a Lambert Conic Conformal map projection was used. The AML script create_projected_network.aml was used to perform these projections and was run as follows:

% arc '&r create_projected_network.aml'

Once the networks were properly projected, it was necessary to manually determine the external station locations to be used in the gravity model. The same external stations that were used in ITN v.1.0 were used in ITN v.2.0 (Figure 3-2). The file external_stops.dat, a comma-delimited ASCII file, was populated with a station identifier, which for this study was an arbitrary number greater than 1000, and the node number, which was manually extracted from the ARC/Info file containing the projected Caltrans statewide network (e.g., caltrans_prj.nat).

Once the stop points for the external stations have been identified, the interzonal routes can be computed. The interzonal routes are the shortest distance between the TAZs that are used to estimate transit times. The ARC AML script routes.aml is used to do the following: one, finds the location of the maximum VMT in each county; two, creates the interzonal stop points for the network based on the location of the maximum VMT in each county; three, computes the shortest distance between the stop points; and four, computes the distance matrix that is used by the gravity model to estimate transit times. routes.aml calls three SAS programs that are also in the directory "gravity_model:" points.sas; stops.sas; and distance_matrix.sas. The script has basic documentation on how to alter the script to run for a particular installation. The script is run as follows:

% arc '&r routes.aml'

routes.aml produces a comma-delimited ASCII file called "dist.csv" that is suitable for input to the gravity model. The gravity model, "Commercial vmt gravity model.xls," is codified using Microsoft Excel 2000 and Microsoft Visual Basic 6.0. Supporting data are in the Excel workbook "2000 ca aadt (trucks).xls." It is necessary to load the comma-delimited ASCII file "dist.csv" into the worksheet "Trip Times" of the "Commercial vmt gravity model" Excel spreadsheet. This should be a simple matter of opening the "dist.csv" file in Excel and copying and pasting the data to worksheet. Once pasted into the "Trip Times" worksheet, it is necessary to alter the intrazonal distances, identified as "." in the "Trip Times" worksheet, to a representative intrazonal distance. In this study, four miles is used per USDOT (1996).

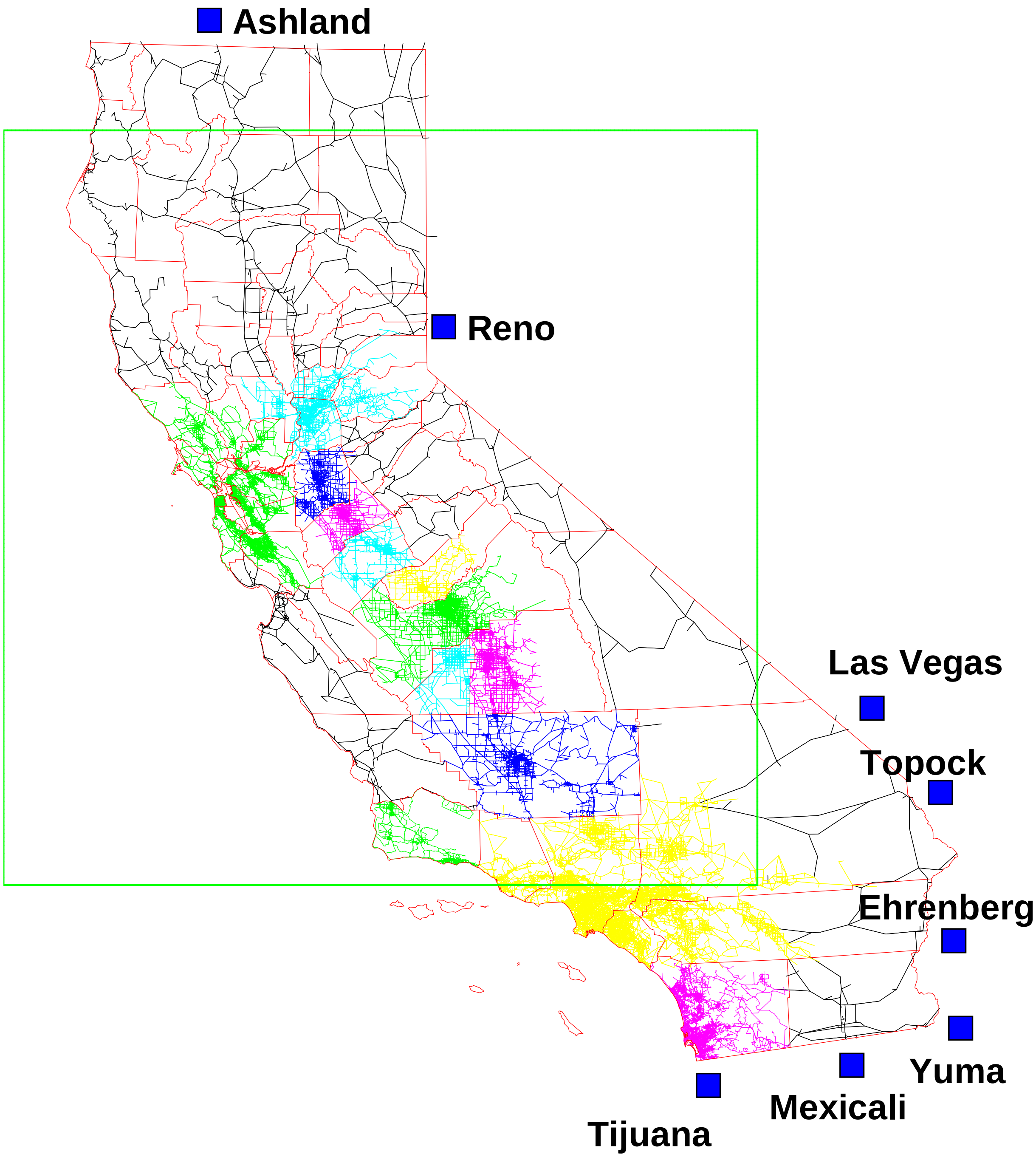

Figure 3-2. Version two of the Integrated Transportation Network (ITN v.2.0) for California. The green, purple, yellow, cyan and blue links indicate portions of the ITN developed from network data that were supplied by local MPOs. The black links indicate portions of the ITN developed from the Statewide network that was supplied by Caltrans. The green box shows the extent of the CCOS air quality modeling domain. The red lines indicate the extent of California counties as well as the extent of the pseudo-transportation analysis zones used in the gravity model. The blue boxes indicate the approximate locations of the external stations.

After the worksheets “Trip Times” and “Truck AADT” have been established, it is possible to run the gravity model for each type of truck: 2-axle; 3-axle; 4-axle; and 5-axle. To run a particular gravity model, select the appropriate worksheet, for example, “Gravity Model (4-axle).” From the main Excel menu, select Tools-Macro-Macros. The Macros pop-up window should appear containing the four types of gravity models. Highlight “GravityModel_4axle” and select “Run.” After five minutes or so, depending on the number of iterations requested (i.e., grid cell A81), the gravity model should stop. The user should take care to review that the convergence criteria is met. If cell A79 is greater than zero, then the absolute convergence criterion has not been met. Though this may seem problematic, it is common for this to occur and usually is due to a problem at distributing trips to the external stations. If the user feels so compelled, the trips can be manually distributed though in the current study, no such action was taken (i.e., once the gravity model ran, the trip distribution was used as-is). Each gravity model must be run for each truck type.

The results of gravity model run (i.e., cells D3 through BQ69) are saved to comma-delimited ASCII files with the following naming scheme: #_axle_commercial_trips.csv where # is replaced by the number of axles. Four Excel macros: Export_2_axle_results; Export_3_axle_results; Export_4_axle_results; and Export_5_axle_results, are provided to help with the process of exporting the gravity model results. These results are the estimated intrazonal and interzonal commercial trip volumes.

Now that the trips have been estimated, it is necessary to distribute the trips to the network links. This is done by running distribute_trips_to_network.sas:

```
% sas distribute_trips_to_network.sas
```

This SAS script reads the route data that were created previously (and identifies the routes between TAZs) and distributes the trips along the routes.

The link-based commercial VMT was estimated by multiplying the number of link-based truck trips by the link distance and the resulting VMT was distributed to the network. This was accomplished by running the AML add_trips_to_network_and_compute_commercial_vmt.aml. Further, this AML script transfers the pertinent results to the Caltrans network that is representative of only those links that were used to build the ITN v.2.0. The AML script is run as follows:

```
% arc ‘&r add_trips_to_network_and_compute_commercial_vmt.aml’
```

The total commercial VMT that resulted from this effort was 35,507,120 miles from 9,093,962 truck trips as compared to 52,844,288 miles from 12,272,921 truck trips as estimated for ITN v.1.0. The primary reason that the commercial VMT estimate dropped from ITN v.1.0 to ITN v.2.0 is that additional local networks, where presumably commercial VMT was estimated, were used in the construction of ITN v.2.0.

3.3 Step 3 – Merge Local Networks into One Consistent Network

In the previous section, the data that were used to develop the ITN v.2.0 were described. Further, the ARC/Info scripts that were used to cast the data from the disparate networks into a consistent format were also described. An additional function of the ARC/Info scripts was to project the networks from their base map projections to a common map projection. This work element was necessary so that the networks could be joined into a seamless entity. For purposes of this study, the common coordinate system was the geographic coordinate system (i.e., longitude and latitude coordinates).

Once the individual networks were in a consistent framework, it was then possible to join all the networks into an integrated transportation network framework. Though the individual networks suffered from some positional error in the link placements, most notably at the boundaries of the networks, this error was significantly minimized as compared to those networks that were used to build the ITN v.1.0. Indeed, it was determined that it was not necessary to manually modify links to reposition them so as to be better positioned. This provides the advantage of using the MPO-supplied networks virtually as-is; hence, the laborious task of manually modifying links was eliminated with the development of the ITN v.2.0.

However, it must be stated that upon close inspection of the ITN v.2.0, "breaks" in the network will be discovered. For example, the links that represent Interstate 5 and Sate Highway 45 as it traverses from Colusa County (links provided via the Caltrans network) to Yolo County (links provided by the SACMET network) will exhibit a noticeable break at the county boundaries. The maximum error of this break is 8,000 meters (i.e., two, four kilometer grid cells in CCOS air quality modeling domain).

One additional step was taken to assure that the ITN was geographically accurate. The National Highway Planning Network (NHPN – FHwA, 2000) was used to check the accuracy of ITN v.2.0. The National Highway Planning Network (NHPN) is a 1:100,000 scale network database that contains line features representing just over 450,000 miles of current and planned highways in the United States, District of Columbia, and Puerto Rico. The NHPN consists of interstates, principal arterials, and rural minor arterials. In particular, the NHPN represents 24,868 miles of roadway for California. The NHPN for California was used to align network roadways and to estimate overall positional error in the ITN in urban areas.

3.3.1 Summary of ITN v.2.0

Figure 3-3 shows the link-based ITN v.2.0 that resulted from the efforts of editing and joining the local transportation networks and the Caltrans statewide transportation network into a seamless network. Figure 3-4 shows the TAZs for ITN v.2.0.

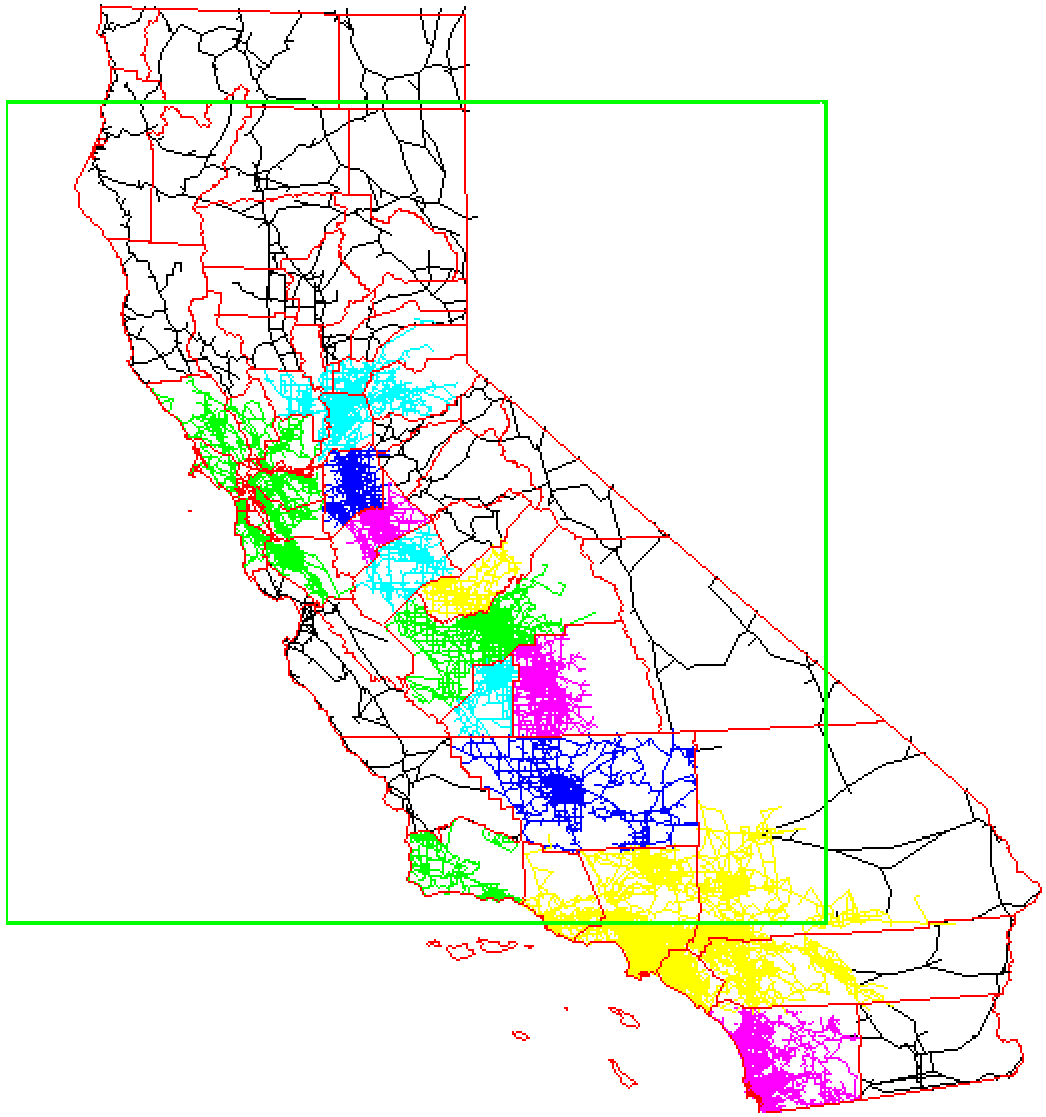

Figure 3-3. Link-based ITN v.2.0. County boundaries are in red. The Caltrans statewide network is in black. The various individual networks are in colors other than black or red. The 190 by 190 04 km CCOS emissions modeling is shown as the green box.

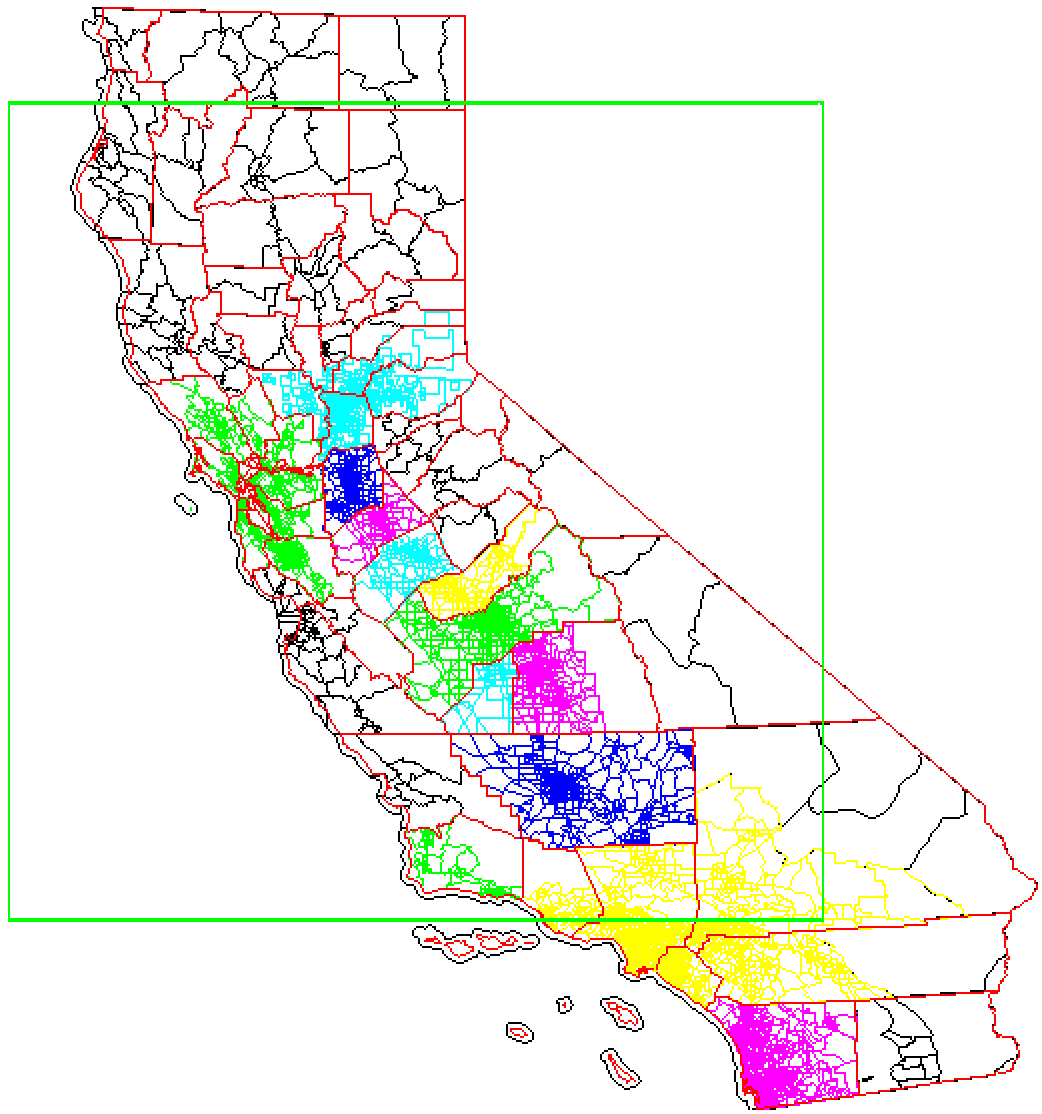

Figure 3-4. TAZ-based ITN v.2.0. County boundaries are in red. The Caltrans statewide TAZ boundaries are in black. The various individual TAZs are in colors other than black or red. The 190 by 190 04 km CCOS emissions modeling is shown as the green box.

3.3.2 Potential Spatial Error in ITN

During the editing and joining process of creating the ITN v.2.0, it was apparent that spatial error existed in the networks used to construct the ITN v.2.0. As identified by Wilkinson (2004), the largest, probable source of the spatial error was due to the lack of specific information that identified the map projection parameters in the networks. The new networks that were used to build the ITN v.2.0 appear to be on average no more than 300 meters in error in urban areas based on a crude overlay of the FHwA network (FHwA, 2000). The maximum urban error exists in the SCAG network where some of the east-west link coordinates appear to be about 600 meters in error whereas the north-south link coordinates appear to be about 200 meters in error at the maximum.

As stated previously, there is also error introduced due to the lack of manually modifying links at network interfaces which almost always occur in rural areas. The maximum extent of the positional error in rural areas is 8,000 meters and occurs at locations with very low VMT (e.g., State Highway 16 traversing the Colusa-Yolo counties border). The average positional error in the rural regions where different networks bordered on another is estimated to be 750 meters.

4 EXAMPLE VMT DISTRIBUTIONS

A complete set quality assurance plots and animations have already been provided in regards to the resulting distributions of VMT by vehicle class for ITN v.2.0. In the following section, examples of these quality assurance plots are provided.

Figure 4-1 shows the distribution of VMT for the entire fleet on the ITN for the 04 km CCOS emissions modeling domain on 16 July 2000 at 2300 hours. The purpose of scaling the VMT so (i.e., 0 VMT to 1.0 VMT) is to show that all major roadways are represented in ITN v.2.0 whereas in ITN v.1.0 there was so concern that certain roadways may have been excluded in the analysis (e.g., Highway 1 in San Luis Obispo and Monterrey counties).

Figures 4-2 through 4-6 show the distribution of VMT for gasoline fueled passenger cars on the ITN for the 04 km CCOS emissions modeling domain on 16 July 2000 for the progression of hours from 0500 through 0900 hours. The purpose in displaying this series of graphics is to show that the VMT distribution has a more orderly progression from hour to hour for ITN v.2.0 in contrast to that for ITN v.1.0 where, in particular for the SCAG network, the hour to hour VMT progression was unusual.

Figures 4-7 and 4-8 show the VMT distribution for gasoline and diesel fueled heavy heavy-duty vehicles (i.e., EMFAC 2002 vehicle class HHDT7) for the 04 km CCOS emissions modeling domain on 16 July 2000 at noon. The purpose in showing these graphics is to demonstrate that ITN v.2.0 distinguishes travel among fuel types and that diesel fueled vehicles dominate travel for HHDT7 vehicles.

Figures 4-9 through 4-13 shows the progression of VMT distribution for diesel fueled school buses for the 04 km CCOS emissions modeling domain on 16 July 2000 from 0500 through 0900 hours. The purpose of these graphics is to show the on-off nature of the VMT for certain vehicle classifications as manifested in the underlying default data that resides in EMFAC2002. Another reason for showing these graphics is to demonstrate a problem that still manifests itself in the ITN v.2.0 – VMT for school buses, and other vehicle classes, appear on all road-ways though is still concentrated in urban cores. That is to say, it is unlikely that school buses operate on every link in the ITN; however, because of the use of EMFAC2002 default vehicle mix data, it was not possible given the project resources to isolate school bus travel only to those links where such travel was most likely to occur.

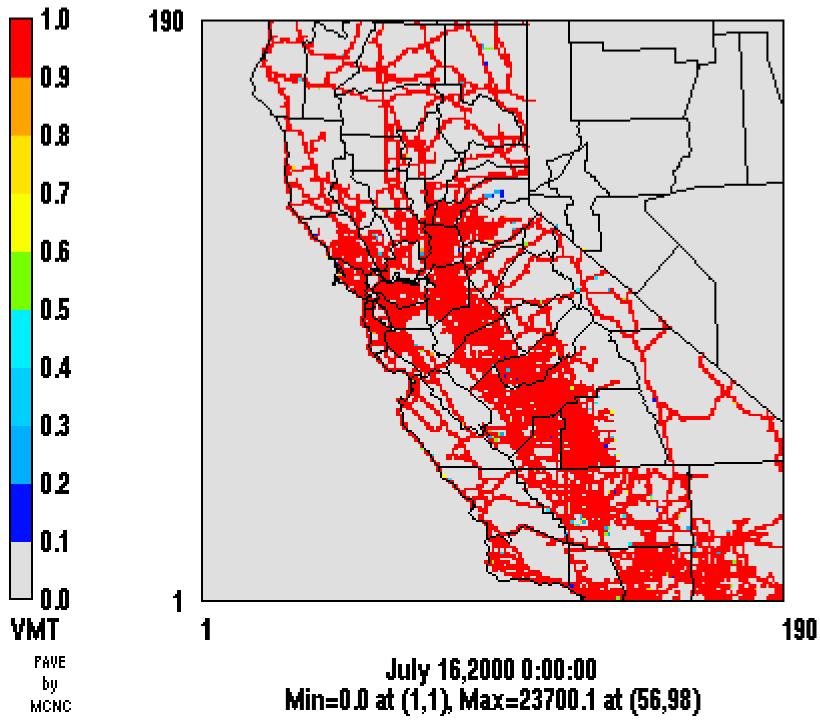

Figure 4-1. Fleet VMT distribution on 16 July 2000 at 2300 hours.

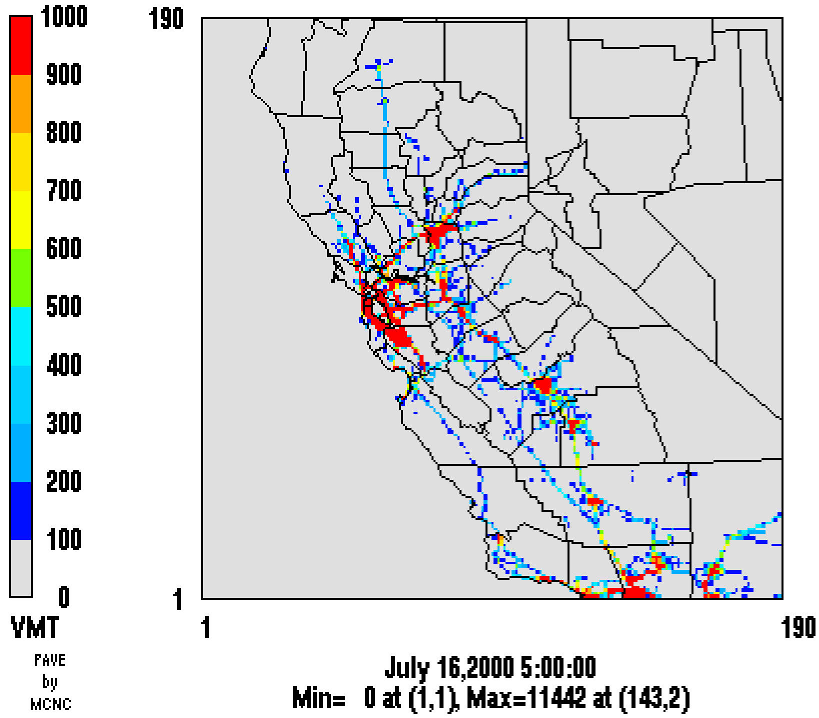

Figure 4-2. VMT distribution for gasoline fueled passenger cars on 16 July 2000 at 0500 hours.

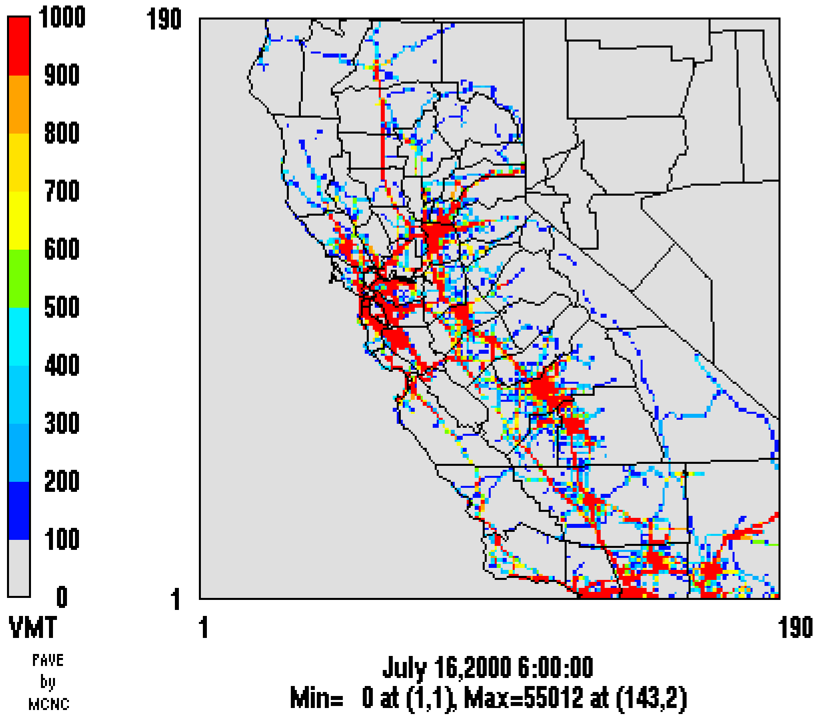

Figure 4-3. VMT distribution for gasoline fueled passenger cars on 16 July 2000 at 0600 hours.

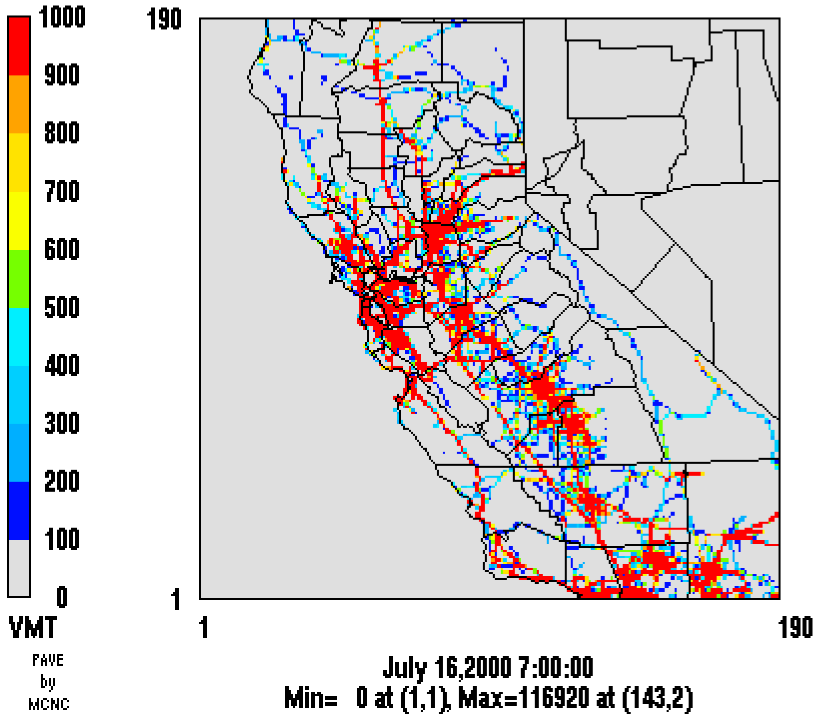

Figure 4-4. VMT distribution for gasoline fueled passenger cars on 16 July 2000 at 0700 hours.

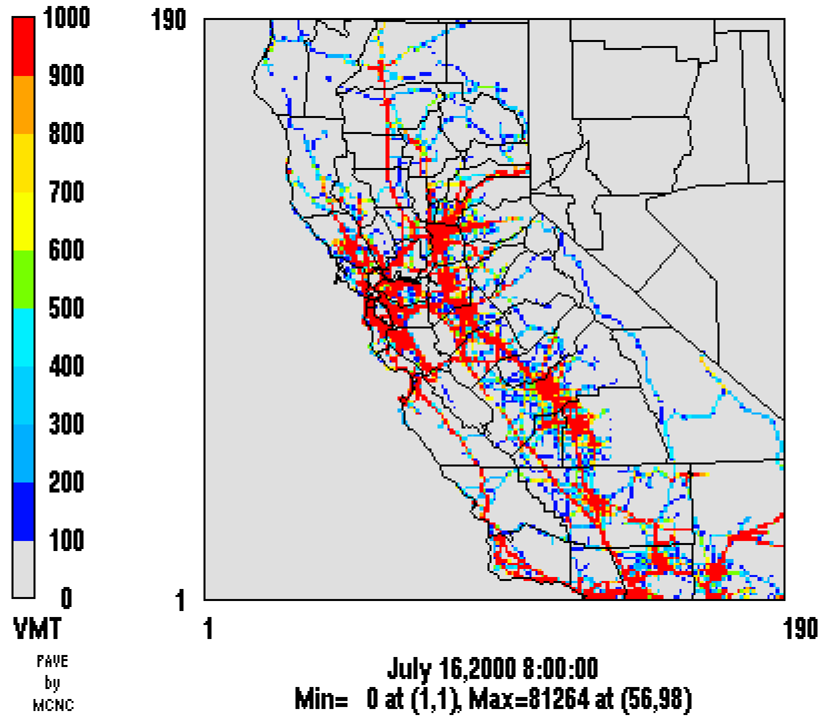

Figure 4-5. VMT distribution for gasoline fueled passenger cars on 16 July 2000 at 0800 hours.

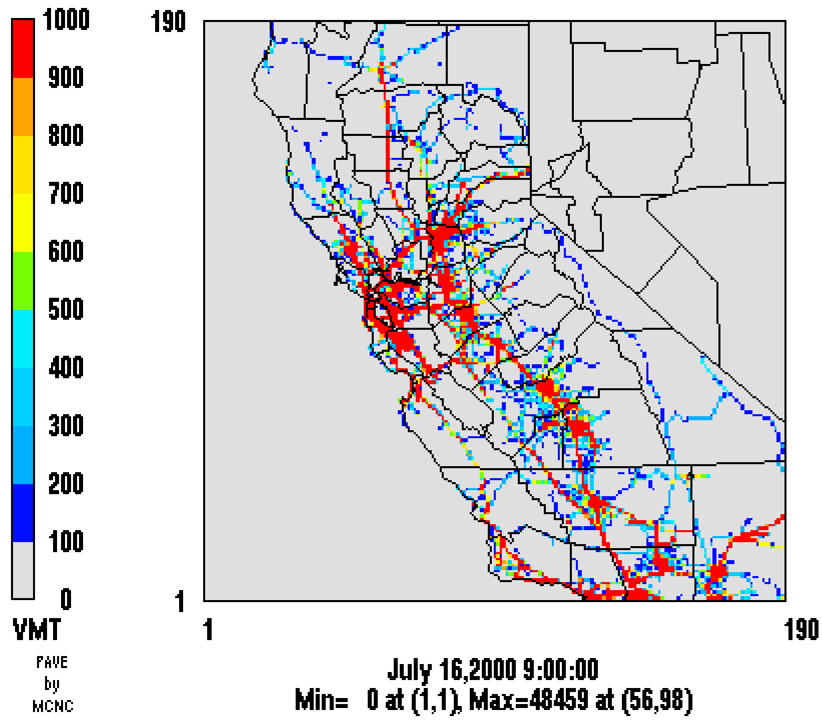

Figure 4-6. VMT distribution for gasoline fueled passenger cars on 16 July 2000 at 0900 hours.

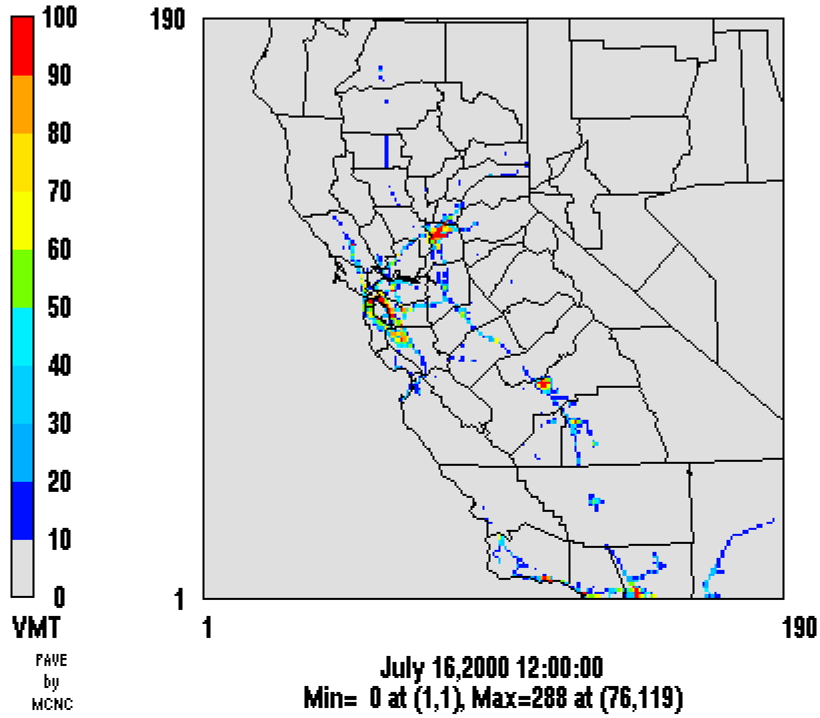

Figure 4-7. VMT distribution for gasoline fueled HHDT7 vehicles on 16 July 2000 at noon.

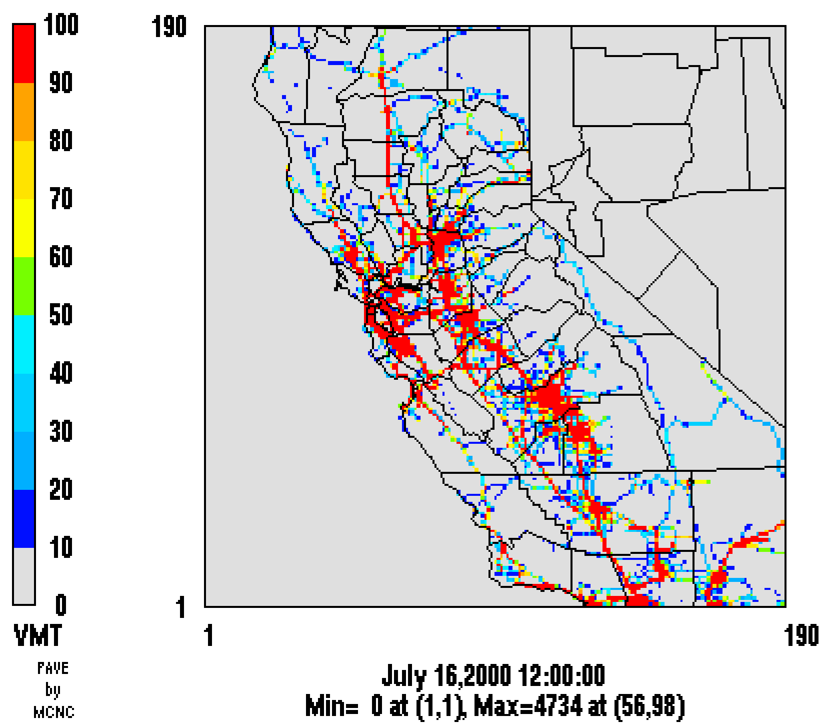

Figure 4-8. VMT distribution for diesel fueled HHDT7 vehicles on 16 July 2000 at noon.

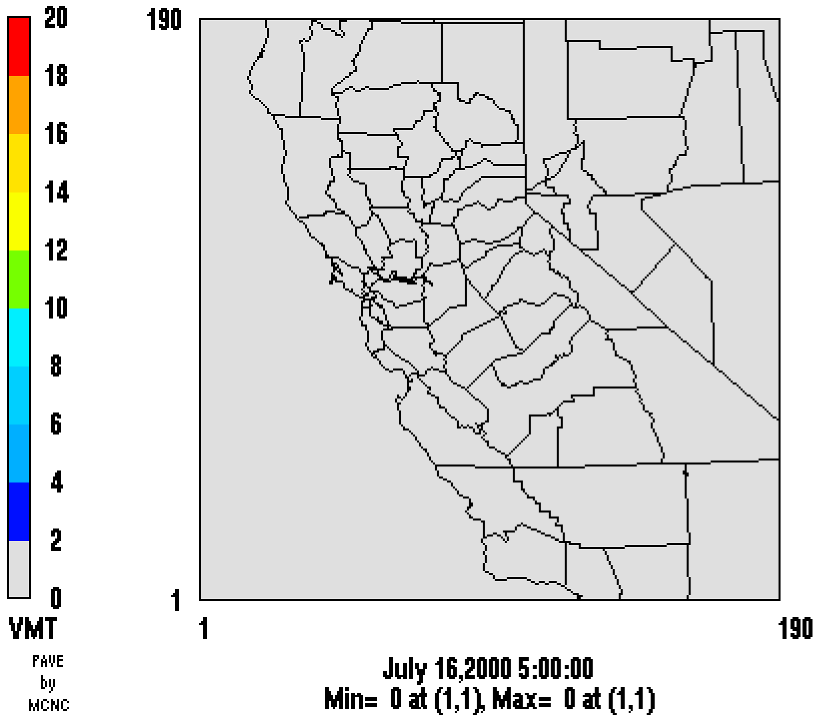

Figure 4-9. VMT distribution for diesel fueled school buses on 16 July 2000 at 0500 hours.

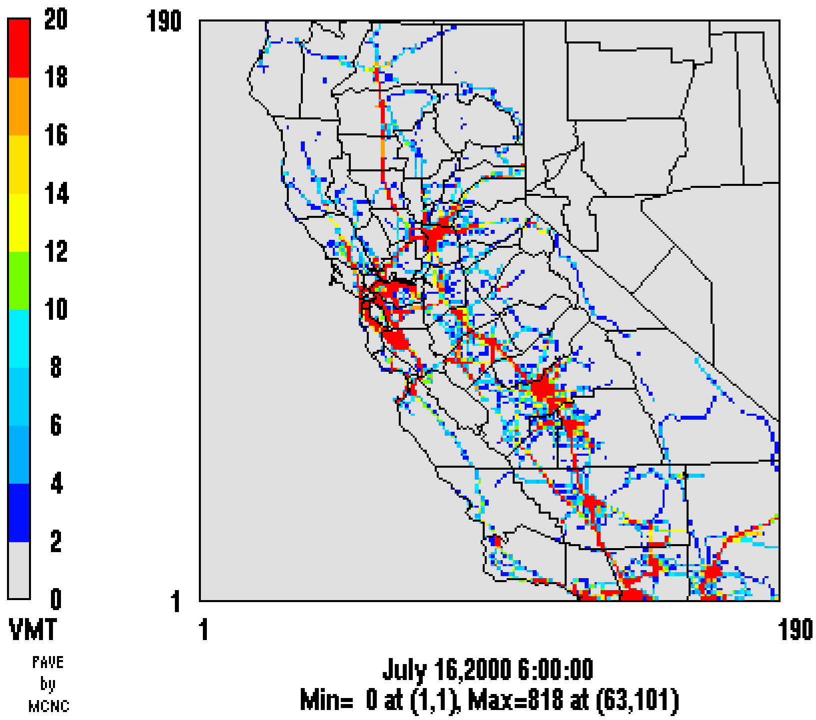

Figure 4-10. VMT distribution for diesel fueled school buses on 16 July 2000 at 0600 hours.

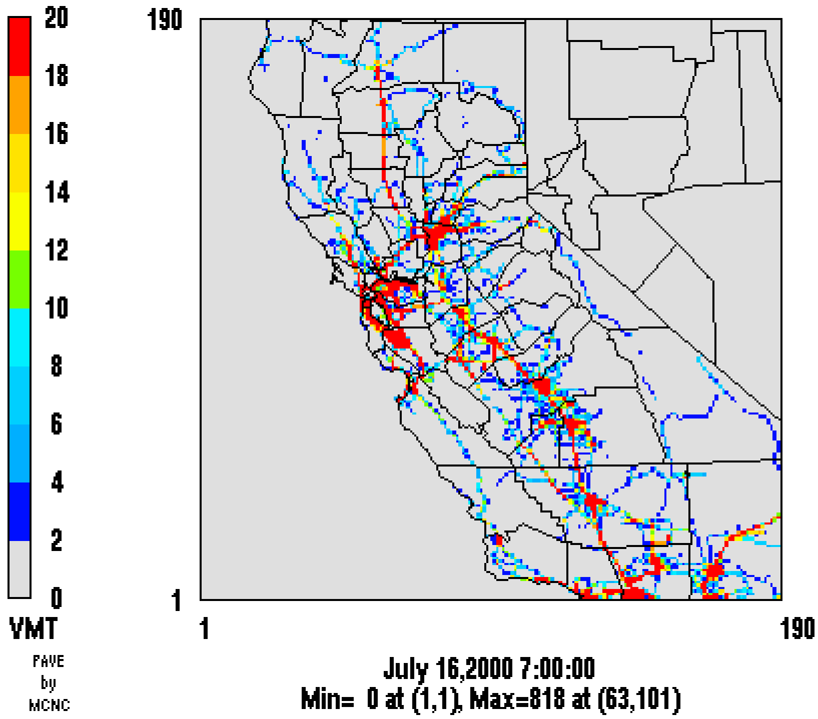

Figure 4-11. VMT distribution for diesel fueled school buses on 16 July 2000 at 0700 hours.

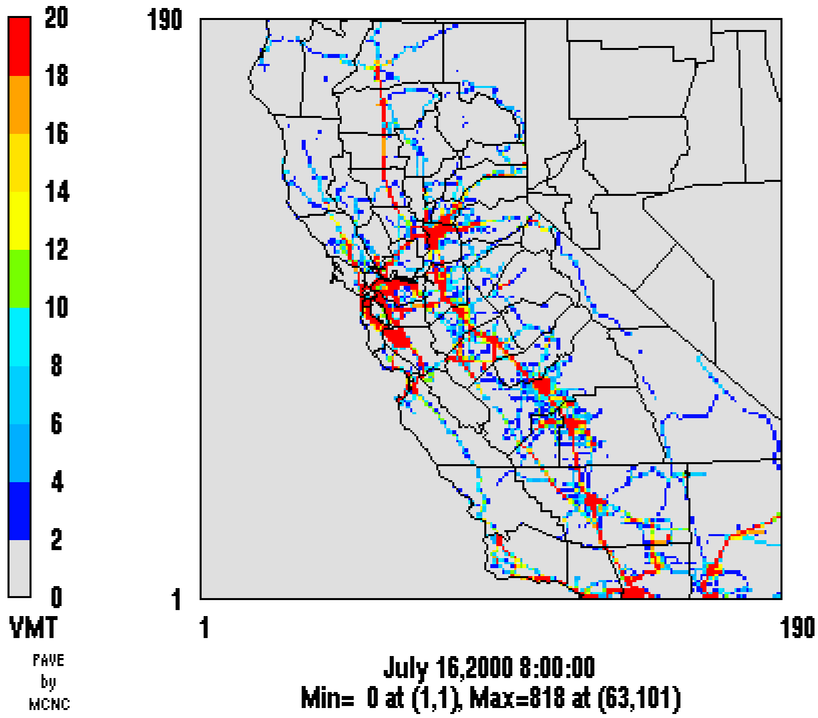

Figure 4-12. VMT distribution for diesel fueled school buses on 16 July 2000 at 0800 hours.

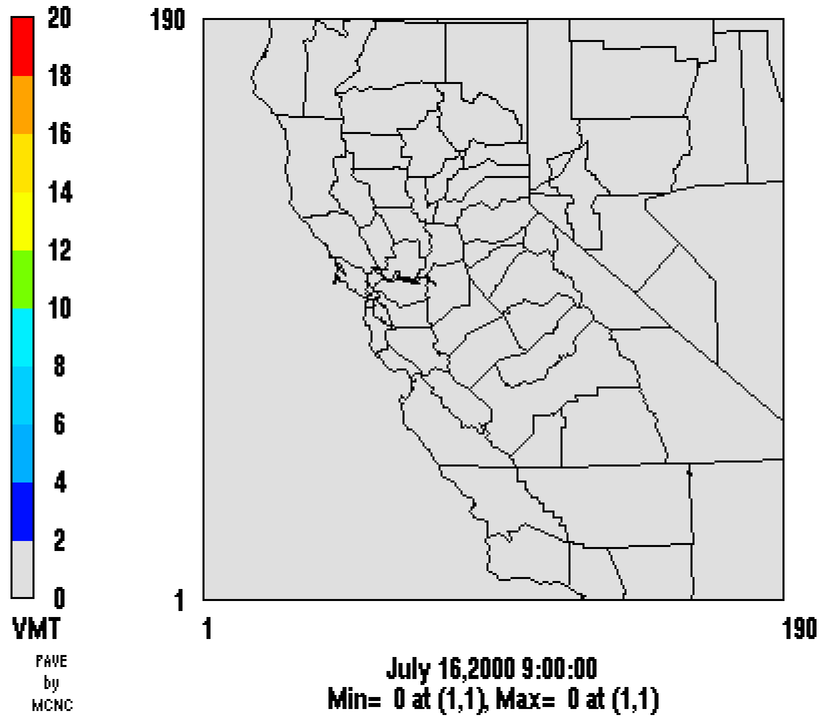

Figure 4-13. VMT distribution for diesel fueled school buses on 16 July 2000 at 0900 hours.

5 CONCLUSION

The data and processes that were used to develop version two of the Integrated Transportation Network (ITN v.2.0) have been described. It was constructed using transportation data that was provided by a number of transportation planning agencies including the California Department of Transportation. It was built using the ARC/Info. The ITN v.2.0 is a California statewide representation of the on-road transportation network. It contains transportation data, including VMT, for personal and commercial travel for a typical weekday for the thirteen EMFAC2002 vehicle classes.

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A APPENDIX A: RESPONSE TO COMMENTS ON DRAFT FINAL ITN REPORT

A.1 Comments in Regards to Excluding the Madera, SCAG, and San Diego Networks.

Numerous emails were exchanged in regards to the study team's decision to exclude the Madera Network. For each comment, the email(s) is (are) included herein. Where multiple emails address a comment, the emails are listed by descending date. Responses to comments are included as well.

A.1.1 Comment (1)

Subject: FW: Draft ITN Report Available for Review
From: David Nunes <David.Nunes@valleyair.org>
Date: Thu, 14 Apr 2005 10:42:10 -0700
To: "Vernon M. Hughes (E-mail)" <vhughes@arb.ca.gov>

Do you have any updates on this project. Mainly..

(1) Did Jim Wilkinson ever let anyone know that there was a problem? I never heard anything on the gridded calls.
(2) Did he try my suggestion of using the Fresno parameters?
(3) What is your opinion?

You don't need to make a lot of lengthy comments, I just would like an update something today so I can determine my tasks for next week.

Thank You,

David Nunes

A.1.2 Response to Comment (1)

Subject: Re: [Fwd: FW: Draft ITN Report Available for Review]
Date: Mon, 18 Apr 2005 16:52:59 -0700
From: James G Wilkinson <jgw@alpinegeophysics.com>
To: David.Nunes@valleyair.org <David.Nunes@valleyair.org>, Mike Bitner <mbitner@fresnocog.org>
CC: vhughes@arb.ca.gov, "Cheryl A. Taylor" <rcataylor@arb.ca.gov>
References: <425EACEA.58220697@arb.ca.gov>

David,

****
Do you have any updates on this project. Mainly..

(1) Did Jim Wilkinson ever let anyone know that there was a problem? I never heard anything on the gridded calls.
(2) Did he try my suggestion of using the Fresno parameters?
(3) What is your opinion?

You don't need to make a lot of lengthy comments, I just would like an update something today so I can determine my tasks for next week.
****

Vernon asked me to respond directly to this request.

In response to question (1), yes I did let someone know about the problem. I alerted Mike Bitner around the July-August timeframe in regards to Madera having map projection problems. Unfortunately, I cannot pinpoint that set of specific emails since in September, I lost a couple of hard drives including my primary backup drive (I am still paying the price for having lost all that data). My recollection at that time was Madera had no idea what the projection parameters were for their network. In a recent phone call with Mr. Bitner, I asked him to confirm all the projection parameters for the central valley counties. In an email from him today, I received confirmation that Madera has no idea what the projection parameters are for their network.

I also do not recollect bringing up this problem on the conference calls. I suspect that I did not bring this problem to light in the conference calls since Mr. Bitner has been so helpful in resolving issues associated with the central valley networks (i.e., I did not want to raise undo havoc if the problem[s] could be resolved by more direct means).

In response to question (2), I did indeed try the Fresno parameters, but to no success. I have tried many different projections, some of which come close, but not close enough. I am going to call Cari Anderson to see if she might know.

I still have time to integrate the Madera network if I can get a handle on the map projection parameters. As you may recall, a similar issue happened with the Stanislaus network in ITN v.1.0. In that case, the Stanislaus network used internal TDM coordinates (I think that it was Viper) which could not be conflated to real world coordinates outside of the TDM software.

This is just a quick response to your questions. I hope it helps. If things changes, I will alert you.

Regards,

Jim

A.1.3 Additional Response to Comment (1)

Since the time of the exchange of these emails, the conflation parameters for the Madera network were determined through trial and error. Hence, the Madera network and its associated data are now a component of ITN v.2.0.

A.1.4 Comment (2)

Subject:ITN Report
Date: Fri, 08 Apr 2005 14:05:43 -0700
From: Cheryl Taylor <cataylor@arb.ca.gov>
To: James G Wilkinson <jgw@alpinegeophysics.com>
Hi Jim,
Steve Shaw just called me. He would like you to put more explanation in the report about why Madera was not included. I also see that new data for SCAG and San Diego could not be used either. Since we really wanted to update those areas in this contract, I think more explanation of what happened would be appropriate. If possible, could you also put in a way to solve these problems? Is there anything that could be done to include them, even in the future? Perhaps we can discuss this more on the 19th. Thanks, Cheryl

A.1.5 Response to Comment (2)

In subsequent follow up work with Bill McFarlane from San Diego, the study team received a new network coverage for San Diego. The new San Diego network coverage has been integrated into the ITN v.2.0.

Since the time of the exchange of these emails, the conflation parameters for the SCAG network were determined through trial and error. Hence, the SCAG network and its associated data are now a component of ITN v.2.0.

A.1.6 Series of Emails Associated with Comment (3)

Subject:RE: ITN Update
Date: Mon, 2 May 2005 13:57:16 -0700
From: David Nunes <David.Nunes@valleyair.org>
To:'James G Wilkinson' <jgw@alpinegeophysics.com>
CC: Cheryl Taylor (E-mail) <cataylor@arb.ca.gov>
Jim,

Do you have any updates to report? Was anything I supplied useful? I have a version of the Madera TAZ I sent you that now has a projection assigned, but I doubt you need it. It appears that I might have SARMAP era transportation files also, but have not yet tried to locate them. I wanted to check your situation before I completed an additional investigation? BTW, where can I get copies of the Madera files?

David Nunes

Subject:[Fwd: Draft ITN Report Available for Review]
Date: Fri, 08 Apr 2005 15:52:42 -0700
From: Cheryl Taylor <cataylor@arb.ca.gov>
To: James G Wilkinson <jgw@alpinegeophysics.com>

Jim,
David Nunes had a suggestion regarding Madera. You can look into it. You can read the exchange of notes below. They're concerned that Madera is not in there. Would you please get back to David if you find out anything? It might not hurt to send him a little more information.
Thanks, Cheryl

Subject: RE: Draft ITN Report Available for Review
From: David Nunes <David.Nunes@valleyair.org>
Date: Fri, 08 Apr 2005 15:40:55 -0700
To: 'Cheryl Taylor' <cataylor@arb.ca.gov>

At least our memory is consistent. I have been concerned that SJV missed a meeting and a major piece of information. Should I look through your minutes or are you confident that nothing has been stated by AG about the issue?

BTW, one thought we had is that since Madera transportation is managed by the Fresno COG, Fresno's parameters might work. It would certainly been worth trying.

David

From: Cheryl Taylor [mailto:cataylor@arb.ca.gov]
Sent: Friday, April 08, 2005 3:23 PM
To: David Nunes
Cc: Vernon Hughes
Subject: Re: Draft ITN Report Available for Review

David,
I can't provide much help. I remember Jim saying at most meetings that he had received the data for the San Joaquin Valley. I can't remember him specifically saying that he couldn't use Madera. I know the work plan says that he should include the 4 northern counties of SJV,

including Madera, IF the data are available. I think it would have been better if Jim had brought this to our attention sooner. Cheryl

David Nunes wrote:

Thank you. In addition, do you know of any references to excluding Madera from the ITN that might exist in your minutes or other documents?

David Nunes

A.1.7 Response to Comment (3)

Subject: Madera Update
Date: Fri, 06 May 2005 18:50:35 -0700
From: James G Wilkinson <jgw@alpinegeophysics.com>
To: David Nunes <David.Nunes@valleyair.org>
CC: Cheryl Taylor <cataylor@arb.ca.gov>, Vernon Hughes <vhughes@arb.ca.gov>
References: <0DFFBE2E899E804E9A5710F707122438339788@sjvapcd-mail>

David,

I just received an email from Ms. Cheryl indicating that you wanted an update on my efforts to include the Madera network. I apologize if I have not been keeping you better apprised of my efforts. I have tried a bunch of map projection parameters including the projection parameters from the TAZ file that you sent. I have attempted variations on the map projection on the Fresno network. I have also attempted variations of CA stateplane parameters for CA Zones III, IV, and V. I contacted the Madera County Assessor's Office ((559) 675-7710) but was not able to get to the exact person who knew about specific map projection parameters. I was however able to glean from my brief conversation from one gentleman that in the Assessor's Office, they mainly use a Stateplane system (of which I have attempted variations of). All have failed to properly conflate the Madera network.

I have even messed around with scaling the X and Y coordinates of the Madera network with various map projection parameters. I did this given that I know that the TP+/Viper system can scale the coordinates based on some arcane formulation (in some past instances that I have encountered, the TP+/Viper coordinates were simple multiples of 10 or 100). None of my attemptes were successful.

I have attached an ARC AML file of a sampling of the parameters that I have attempted to conflate the Madera network. None properly conflate the Madera network. I have even attempted a three point affine transformation, but this too failed. This leaves me with a rubbersheeting exercise at this point for which I have no budget. Therefore, at this time, the Madera network will be left out of the ITN version 2.0 development.

For your use, I have placed a zip file containing the raw Madera shape file as I received it, the raw Fresno shape file as I received it, and the Fresnosh apefile in geographic coordinates as I built it from the raw Fresno shape file.
The ftp site is ftp.alpinegeophysics.com. The user and password are arbemiss and cleanair respectively. The zipped shape file can be found in the directory ITNv2.

Sorry to be the bearer of bad news. If you want to discuss this in more detail, please drop me an email or call me (541.345.2525).

Regards,

Jim Wilkinson

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/*33 30 0.0
/*2000000.0
/*500000.0
/*
/*project cover madera_alt madera_geo
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/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
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/*arcs ../fresno/fresno_geo
/*linecolor 2
/*arcs madera_geo

/************************************************
/* Lambert Conformal Conic State Plane Zone V (permutations)
/* true NAD83
/************************************************
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/*kill madera_geo all
/*
/*copy madera_bak madera_alt
/*
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/*projection lambert
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/*units feet
/*parameters
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/*35 28 0.0
/*-118 0 0.0
/*33 30 0.0
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/*1640419.9
/*
/*project cover madera_alt madera_geo
/*output
/*projection geographic
/*units dd
```

```
/*datum nad83
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/*arcs madera_geo

/************************************************
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/* true NAD83
/************************************************
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/*kill madera_geo all
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/*projection lambert
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/*units feet
/*parameters
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/*-118 0 0.0
/*33 30 0.0
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/*1640419.9
/*
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/*output
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/*units dd
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/*parameters
/*end
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/************************************************
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/* true NAD27
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```
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/*units meters
/*parameters
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/*38 26 0.0
/*-120 30 0.0
/*36 30 0.0
/*609601.21920
/*0.0
/*
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/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
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/************************************************
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/************************************************
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/*units meters
/*parameters
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/*38 26 0.0
/*-120 30 0.0
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/*units dd
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/*parameters
/*end
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/*arcplot
```

```
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/*units feet
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/*38 26 0.0
/*-120 30 0.0
/*36 30 0.0
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/*
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/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters

/*end
/*
/*display 9999
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/************************************************
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/*
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/*projection lambert
/*datum nad83
/*units feet
/*parameters
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```

```
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/*-120 30 0.0
/*36 30 0.0
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/*0.0
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/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
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/************************************************
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/************************************************
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/*datum nad27
/*units meters
/*parameters
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/*0.0
/*
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/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
/*arcplot
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/*arcs ../fresno/fresno_geo
/*linecolor 2
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```

```
/***********************************************
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/***********************************************
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/*projection lambert
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/*units meters
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/*37 15 0.0
/*-119 0 0.0
/*35 20 0.0
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/*0.0
/*
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/*output
/*projection geographic
/*units dd
/*datum nad83

/*parameters
/*end
/*
/*display 9999
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/*arcs madera_geo

/***********************************************
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/*
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/*
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/*projection lambert
/*datum nad27
/*units feet
/*parameters
/*36 0 0.0
/*37 15 0.0
/*-119 0 0.0
/*35 20 0.0
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```

```
/*
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/*projection geographic
/*units dd
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/*arcs madera_geo

/************************************************
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/************************************************
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/*kill madera_geo all
/*
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/*
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/*projection lambert
/*datum nad83
/*units feet
/*parameters
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/*37 15 0.0
/*-119 0 0.0
/*35 20 0.0
/*2000988.252
/*0.0
/*
/*project cover madera_alt madera_geo
/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
/*arcplot
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/*arcs ../fresno/fresno_geo
/*linecolor 2
/*arcs madera_geo

/************************************************
/* Lambert Conformal Conic State Plane Zone V
/* true NAD27
/************************************************
/*kill madera_alt all
```

```
/*kill madera_geo all
/*
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/*
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/*projection lambert
/*datum nad27
/*units meters
/*parameters
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/*35 28 0.0
/*-118 0 0.0
/*33 30 0.0
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/*0.0
/*
/*project cover madera_alt madera_geo
/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
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/*arcs ../fresno/fresno_geo
/*linecolor 2
/*arcs madera_geo

/*************************************************
/* Lambert Conformal Conic State Plane Zone V (permutations)
/* true NAD27
/*************************************************
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/*kill madera_geo all
/*
/*copy madera_bak madera_alt
/*
/*projectdefine cover madera_alt
/*projection lambert
/*datum nad83
/*units meters
/*parameters
/*34 2 0.0
/*35 28 0.0
/*-118 0 0.0
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/*609601.21920
/*0.0
/*
/*project cover madera_alt madera_geo
/*output
/*projection geographic
/*units dd
/*datum nad83
```

```
/*parameters
/*end
/*
/*display 9999
/*arcplot
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/*arcs ../fresno/fresno_geo
/*linecolor 2
/*arcs madera_geo

/************************************************
/* Lambert Conformal Conic State Plane Zone V (permutations)
/* true NAD27
/************************************************
/*kill madera_alt all
/*kill madera_geo all
/*
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/*
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/*projection lambert
/*datum nad27
/*units feet
/*parameters
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/*-118 0 0.0
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/*0.0
/*
/*project cover madera_alt madera_geo
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/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
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/*arcs ../fresno/fresno_geo
/*linecolor 2
/*arcs madera_geo


/************************************************
/* Lambert Conformal Conic State Plane Zone V (permutations)
/* true NAD27
/************************************************
/*kill madera_alt all
/*kill madera_geo all
/*
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/*
/*projectdefine cover madera_alt
```

```
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/*units feet
/*parameters
/*34 2 0.0
/*35 28 0.0
/*-118 0 0.0
/*33 30 0.0
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/*0.0
/*
/*project cover madera_alt madera_geo
/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
/*arcplot
/*mape ../fresno/fresno_geo
/*arcs ../fresno/fresno_geo
/*linecolor 2
/*arcs madera_geo

/************************************************
/* From TAZ file supplied by David Nunes
/************************************************
/*kill madera_alt all
/*kill madera_geo all
/*
/*copy madera_bak madera_alt
/*
/*projectdefine cover madera_alt
/*projection lambert
/*datum nad83
/*units feet
/*parameters
/*33 54 38.0
/*39 13 33.0
/*-119 37 30.0
/*33 54 38.0
/*400000.0
/*0.0
/*
/*project cover madera_alt madera_geo
/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
/*arcplot
/*mape ../fresno/fresno_geo
```

```
/*arcs ../fresno/fresno_geo
/*linecolor 2
/*arcs madera_geo

/************************************************
/* From TAZ file supplied by David Nunes (permuations)
/************************************************
/*kill madera_alt all
/*kill madera_geo all
/*
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/*
/*projectdefine cover madera_alt
/*projection lambert
/*datum nad27
/*units feet
/*parameters
/*33 54 38.0
/*39 13 33.0
/*-119 37 30.0
/*33 54 38.0
/*400000.0
/*0.0
/*
/*project cover madera_alt madera_geo
/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
/*arcplot
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/*arcs ../fresno/fresno_geo
/*linecolor 2
/*arcs madera_geo

/************************************************
/* From TAZ file supplied by David Nunes (permuations)
/************************************************
/*kill madera_alt all
/*kill madera_geo all
/*
/*copy madera_bak madera_alt
/*
/*projectdefine cover madera_alt
/*projection lambert
/*datum nad83
/*units meters
/*parameters
/*33 54 38.0
/*39 13 33.0
/*-119 37 30.0
/*33 54 38.0
/*121920.0
```

```
/*0.0
/*
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/*output
/*projection geographic
/*units dd
/*datum nad83
/*parameters
/*end
/*
/*display 9999
/*arcplot
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/*arcs ../fresno/fresno_geo
/*linecolor 2
/*arcs madera_geo

/************************************************
/* From TAZ file supplied by David Nunes (permuations)
/************************************************
kill madera_alt all
kill madera_geo all

copy madera_bak madera_alt

projectdefine cover madera_alt
projection lambert
datum nad27
units meters
parameters
33 54 38.0
39 13 33.0
-119 37 30.0
33 54 38.0
121920.0
0.0


project cover madera_alt madera_geo
output
projection geographic
units dd
datum nad83
parameters
end

display 9999
arcplot
mape ../fresno/fresno_geo
arcs ../fresno/fresno_geo
linecolor 2
arcs madera_geo
```

A.2 Comments Regarding Suspect Problems in Hourly VMT Distribution.

Numerous comments were made in regards to how the VMT were distributed by hour for many of the vehicle classes:

1. The MHDT6_GAS and HHDT7_GAS turn off at hours 4 and 5.
2. MHDT6_DIE turns off at hours 3, 4, and 5.
3. The time seems a little late for school buses in the afternoon from hours 16, 17 and 18. That's 4 pm through 7 pm. School busses show no VMT during school hours. I would expect a little VMT during the day.
4. The motor home hourly profile looks odd. Hour 3 goes back up after dropping off in the evening and then drops to 0 during hours 4 and 5. Then there's a small spike at hour 6, but backing way off for hours 7 and 8. Hour 9 has the highest spike of the day, then way up and down from hours 11 through 18
5. The LHDT4_GAS hourly profile has two spikes at hours 3 and 18 that seem unusually high.
6. LHV is all 0.
7. LHDT4_DIE has no VMT for hours 5 and 6, but VMT for all other hours.

In all virtually all cases, the VMT distribution by vehicle class comes directly from EMFAC2002. After reviewing the data, indeed it is the case that these “unusual” VMT distributions are a direct result of using EMFAC2002 data.

A.3 Comments Regarding Other Issues.

Comment A.3.1: Why are electric vehicles even in the network since we won't calculate emissions? I thought it might be that we are tracking electric VMT even though we won't use the emissions, but there is no electric VMT in the netcdf file to even review.

Response A.3.1: Data for electric vehicles are carried internal to EMFAC2002 and are simply passed through for use in the ITN v.2.0.

Comment A.3.2: Counties without local transportation networks supplied to the ITN show no VMT at all. Shouldn't they at least have VMT on the state network? Is the state network missing from the entire file?

Response A.3.2: This was an oversight in an early release of ITN v.2.0 and has been corrected in the final version of ITN v.2.0.

Comment A.3.3: There is a group of cells in the southeastern part of Santa Clara County which does not seem to coincide with any major roads. (Google map indicates a state park out there). Any ideas what that traffic is associated with?

Response A.3.3: After reviewing the raw MTC network, these links indeed appear. The links do not appear to carry any unusually high volumes of traffic as if they might be unidentified cordon links. At this time, it is not possible for the project team to investigate this issue further as all project resources have been expended.

Comment A.3.4: (From Pam Burmich, ARB, 26 April 2005, via email) In Table 2-4 there are some major changes year to year in the magnitude and direction of VMT growth factors (e.g., Butte, Fresno, San Luis Obispo, Santa Barbara, Solano, Yuba counties). Please confirm these factors are reasonable.

Response A.3.4: Per the cited data that were used to prepare the growth factors, the numbers reported in the Table are correct. This same information is apparently used by the Federal Highway Administration in preparing VMT forecasts for their highway performance network (HPN).

Comment A.3.5: (From Pam Burmich, ARB, 26 April 2005, via email) References to South Coast Association of Governments should read Southern California Association of Governments.

Response A.3.5: This has been corrected in the report text.

Comment A.3.6: (From Jim Damkowitch, SBCAG, 19 April 2005, via email) Only mentioning the Central California Ozone Study (CCOS) may give the impression that this effort will only benefit air quality planning efforts in the Central Valley. It should be stated that the ITN will also be potentially available for future air quality attainment demonstrations of both the state 1-hour ozone standard and the new federal 8-hour ozone standard.

Response A.3.6: The report text has been revised to reflect the potential use of the ITN in other studies related to air quality in California.

Comment A.3.7: (From Jim Damkowitch, SBCAG, 19 April 2005, via email) Two peak hours for both the AM and PM peak periods are shown for Santa Barbara County respectively. This should be revised to reflect just one peak hour in the AM (0700-0800) and PM (1600-1700) respectively. The Off-Peak hourly distribution should be revised accordingly.

Response A.3.7: This has been corrected.

Comment A.3.8: (From Jim Damkowitch, SBCAG, 19 April 2005, via email) I've never heard of US Federal Highway Authority data. I believe you may be referring to the Federal Highway Administration Highway Performance Monitoring Program (HPMS) data.

Response A.3.8: You are indeed correct that these references should be to the Federal Highway Administration. This has been corrected.

Comment A.3.9: (From Jim Damkowitch, SBCAG, 19 April 2005, via email) Given that these factors are based on the CCOS study – are the weekend factors of the more coastal areas such as Monterey County, Santa Barbara County, Santa Cruz County etc., empirically based? What about other destination resort areas such as the Lake Tahoe portions of Placer and El Dorado

County? What data was used to derive the scaling factors in these areas and was there any special consideration given to tourism impacts?

Response A.3.9: The weekend scaling factor issue is still unresolved. Therefore, in the final version of the ITN, no effort was expended to scale the weekday data to weekend day values. References to this work have been deleted from the report text.

Comment A.3.10: (From Jim Damkowitch, SBCAG, 19 April 2005, via email) Add Commercial VMT to Caltrans Statewide Network – SBCAG concurs with this approach (i.e., the approach described in the final report).

Response A.3.10: Thank you for your comment.